CONTENTS

Page

SUMMARY 1 1/A5
INTRODUCTION 1 1/A5
AERODYNAMIC DESIGN 2 1/A6
Velocity Diagrams 2 1/A6
Loss Model 3 1/A7
Blade Shapes 4 1/A8
Rotors 5 1/A9
Stators 6 1/A10
MECHANICAL DESIGN 7 1/A11
APPARATUS AND PROCEDURE 7 1/A11
Compressor Test Facility 7 1/A11
Test Stages 8 1/A12
Instrumentation 8 1/A12
Test Procedure 9 1/A13
Calculation Procedure 9 1/A13
RESULTS AND DISCUSSION 10 1/A14
Overall Performance 10 1/A14
Stage 35 . . . . . 10 1/A14
Stage 36 . . . . . 11 1/B1
Stage 37 . . . . . 11 1/B1
Stage 38 . . . . . 11 1/B1
Effects of Design Pressure Ratio Level on Overall Performance 12 1/B2
Effects of Aspect Ratio on Overall Performance 13 1/B3
SUMMARY OF RESULTS 13 1/B3

APPENDIXES

A - SYMBOLS 15 1/B5
B - EQUATIONS 18 1/B8
C - BLADE MANUFACTURING COORDINATES 24 1/B14
REFERENCES 63 1/E11
TABLES 64 1/E12
FIGURES 77 1/F11

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Design and Overall Performance of Four Highly Loaded, High-Speed Inlet Stages for an Advanced High-Pressure-Ratio Core Compressor

Lonnie Reid and Royce D. Moore

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Lonnie Reid and Royce D. Moore
Lewis Research Center
Cleveland, Ohio

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and Space Administration

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SUMMARY

This report presents the design and overall performance of four inlet stages for an advanced core compressor. Rotor solidity, stator solidity, rotative speed, mass flow, and flow-path geometry were the same for all configurations. These four stages represent two levels of design total pressure ratios (1.82 and 2.05), two levels of rotor aspect ratios (1.19 and 1.63), and two levels of stator aspect ratios (1.26 and 1.78). The individual stages were tested over the stable operating flow range at 70, 90, and 100 percent of design speeds. The performances for the low-aspect-ratio configurations were substantially better than those of the high-aspect-ratio configurations. The peak rotor and stage adiabatic efficiencies for the low-aspect-ratio - high-pressure-ratio configuration were 0.876 and 0.840, respectively, and occurred at rotor and stage pressure ratios of 2.056 and 2.00, respectively. The peak rotor and stage efficiencies for the low-aspect-ratio - low-pressure-ratio configuration were 0.872 and 0.845, respectively, and occurred at rotor and stage pressure ratios of 1.875 and 1.842, respectively. The peak rotor and stage efficiencies for the high-aspect-ratio - low-pressure-ratio configuration were 0.852 and 0.821, respectively, and occurred at rotor and stage pressure ratios of 1.766 and 1.730, respectively. The rotor and stage peak efficiencies for the high-aspect-ratio - high-pressure-ratio configuration were 0.849 and 0.831, respectively, and occurred at rotor and stage pressure ratios of 1.969 and 1.944, respectively.

INTRODUCTION

A research program on axial-flow fans and compressors for advanced airbreathing engines being conducted at Lewis includes the study of advanced core compressor designs, having high pressure ratio (about 20:1), good efficiency, and adequate stall margin in as few stages as possible. A preliminary study of the aerodynamic and mechanical designs for an eight-stage core compressor having a pressure ratio of 20:1 (ref. 1) resulted in a compressor design of constant meanline diameter, with an inlet hub-tip ratio of 0.7 and an inlet rotor-tip speed of 455 meters per second. Even with this high tip speed, the loading per stage is considerably higher than that in current state-of-the-art core compressors. An experimental research program was therefore undertaken to evaluate the performance characteristics of single stages that are representative of inlet, middle, and rear stages of the eight-stage 20:1 pressure ratio core compressor.

This report describes the designs and evaluates the overall performances of four single stages that are representative of the inlet stage for the advanced-core compressore. These four stages represent two levels of pressure ratio (1.82 and 2.05) and two levels of rotor aspect ratio (1.19 and 1.63). The stages are designated as stages 35, 36, 37, and 38. Design conditions for the four stages are as follows:

Stage	Rotor aspect ratio	Stage pressure ratio
35	1.19	1.82
36	1.63	1.82
37	1.19	2.05
38	1.63	2.05

The overall rotor and stage performances are presented over the stable operating flow range at rotative speeds from 50 to 100 percent of design. The symbols and equations are defined in appendixes A and B.

AERODYNAMIC DESIGN

The basic aerodynamic design procedure consists of selecting flow-path geometry and rotative speed, determining velocity diagrams at blade leading and trailing edge locations, and selecting blade shapes that will produce the desired velocity diagrams. The flow-path geometry and rotative speed for these designs are the same and are based on the design for the first stage of the eight-stage compressor configuration. The stage pressure ratio of 1.82 was also based on the eight-stage configuration; the stage-pressure ratio of 2.05 was selected to provide a comparison of performance at a high design pressure ratio or stage loading for a given level of aspect ratio. The design mass flow is 20.2 kilograms per second. The computer program used to execute these aerodynamic designs does the flow-field calculations, defines the blade elements along individual streamlines, and stacks these blade elements to produce blade manufacturing coordinates. This computer program will be referred to herein as the DCP (Compressor Design Program).

Velocity Diagrams

The flow path geometry for all four stages is the same, and the coordinates are given in figure 1. The rotor and stator leading- and trailing-edge locations are shown in figure 1(a) for stages 35 and 37 and in figure 1(b) for stages 36 and 38.

The CDP calculated the velocity diagrams at several locations, including the leading and trailing edges for the rotor and stator blades, using a streamline analysis computational procedure. This procedure provides an axisymmetric, compressible-flow solution to the continuity, energy, and radial equilibrium equations. Streamline curvature, enthalpy, and entropy gradients were included in the radial equilibrium equation.

The inputs to the DCP required to calculate the velocity diagrams, included rotative speed, flow path geometry, mass flow, overall total-pressure ratio, blade geometry parameters, radial distribution of total-pressure ratio, and correlations of profile loss parameter as a function of diffusion factor for both rotors and stators. Input flow blockages were also included to account for boundary-layer blockage along the casing walls.

Design values of the overall performance parameters for all four stages are given in table I. Stages 35 and 36 were designed for a total-pressure ratio of 1.82 and stages 37 and 38 for a total-pressure ratio of 2.05. All four stages were designed for a mass flow of 20.20 kilograms per second and a rotor tip speed of 455 meters per second. Design blade-element parameters for all four stages are presented in the form of radial distribution plots. Radial distributions of several parameters are presented in figures 2 to 4 for the rotors, stators, and stages. The radial distributions of total-pressure ratio are constant from hub to tip for all four rotors (fig. 2(a)). The radial distributions of rotor-inlet meridional velocity are nearly equivalent for all four rotor configurations (fig. 2(f)); its peak is 215 meters per second at the 50-percent span location, and its minimum is 185 meters per second at both the hub and tip. The radial variations in diffusion factor are relatively small for all four rotors (fig. 2(d)). In rotor 38, for example, the diffusion factor varies from about 0.57 at the tip to about 0.60 at the hub with a peak of about 0.61 near the 90-percent span location. Although the diffusion-factor distributions are similar for all four rotors, the level differs. For the stages with a total-pressure ratio of 2.05, that is, stages 37 and 38, the maximum rotor diffusion factors are 0.58 and 0.61, respectively, and for the configurations with a stage total-pressure ratio of 1.82, that is, stages 35 and 36 are 0.48 and 0.51.

The radial distributions of inlet and outlet Mach number are similar for all four stator configurations (fig. 3). The stator for stage 37 has the highest inlet Mach number, which varies from 0.81 at the hub to 0.735 at the tip. The stator for stage 35 has the highest outlet Mach number, which varies from 0.63 at the hub to 0.573 at the tip.

The radial distributions of diffusion factor (fig. 3(c)) are similar and vary slightly from hub to tip, with the minimum value occurring at about 40 percent span from the tip. The radial distributions of meridional velocity ratio (fig. 3(f) are similar for all four stators with the stator for stage 35 having the highest level of meridional velocity ratio. The stator meridional velocity ratio varies from 1.10 at the tip to 1.049 at the hub for stage 35.

Loss Model

The basic objective in selecting a blade profile is to obtain a blade shape that will produce the desired velocity diagrams with a minimum relative total-pressure loss across the blade row. The general approach in correlating loss data has been to break the total loss into profile and shock losses. The profile loss is attributed to velocity diffusion and the accompanying boundary-layer development on the blade surfaces; the shock loss is attributed to a strong bow shock emanating from the suction surface of the adjacent blade. This shock-loss model was developed by Miller and Hartmann (ref. 2). In the actual flow process through a blade row, the boundary-layer development on the blade surfaces is undoubtedly strongly influenced by the strength of the shocks; thus the profile and shock losses are definitely interrelated. However, a loss model that separates the total loss into a profile loss and a shock loss provides a very useful and systematic way of empirically correlating experimental loss data obtained from blade rows with supersonic inlet relative Mach numbers with the diffusion factor that was developed for subsonic flows by Lieblein (ref. 3). It has been demonstrated that this approach is quite satisfactory in predicting the total loss for new blade designs if correlations of loss data from blade rows with similar inlet relative Mach numbers are used.

The correlations of profile-loss parameter with diffusion factor that were used to obtain profile losses are shown in figures 5(a) and (b) for rotors and stators, respectively. The rotor shock losses (fig. 6) were calculated using the model from reference 2. The designed total losses for all of these rotors and stators are shown in figure 7.

Blade Shapes

In the design of a blade row for low relative total-pressure loss, the general approach is to select a profile that will minimize the peak Mach number as well as the local diffusion on the blade surfaces for a given set of inlet and exit velocity diagrams. Multiple circular arc (MCA) blade profiles were used in the design of all blade rows to accomplish these objectives. The development of the MCA blade profile is discussed in detail in reference 4. The blade elements are defined on an upwrapped conical surface which approximates a surface of revolution generated by revolving the flow streamline about the compressor axis (fig. 8). Blade-element meanline and surfaces are defined based on a constant rate of angle change with path distance (fig. 9). The blade meanline and surfaces have two segments. In the case where the two segments for the meanline have the same turning rate, the profile is referred to as a circular arc meanline. If, in addition to having the same turning rate on both segments, the maximum thickness is located at midchord, the profile is referred to as a double circular arc (DCA). The blade shape is specified by meanline angles at inlet, transition, and outlet and by maximum thickness, leading- and trailing-edge thicknesses, and the locations of maximum thickness and transition points. After the blade-element coordinates are defined, these elements are stacked about their centers of area along a prescribed stacking line. For manufacturing purposes blade section coordinates are provided on a plane x-y coordinate system normal to a radial line as shown in figure 10. The nomenclature for the manufacturing blade-section coordinates are shown in figure 11.

The selection of blade-shape parameters, such as incidence angles, camber distribution, location of maximum thickness, and location of transition point, is made with the objective of obtaining a blade row that is capable of capturing and passing the design flow and producing the required flow turning with low relative total-pressure loss. For blade elements in which the absolute velocity is subsonic but the relative velocity is supersonic, waves are generated by the blade-entrance region and propagate upstream of the blade leading edge (fig. 12). This wave system sets the amount of mass flow the blade element can capture. The structure of the wave system is heavily influenced by the incidence angle and the entrance region camber distributions. In addition, the blade-passage throat area, which is also affected by the camber distribution, must be large enough to pass the captured flow in order to achieve design mass flow. In general, for transonic blade elements, a small amount of front camber tends to reduce the peak suction-surface Mach number and thus shock loss; however, the rear camber must then be increased to obtain the desired flow turning. For blade elements in which the relative velocity is subsonic throughout, the mean flow velocity will be maximum at the throat location. It is therefore desirable to have the throat at or near the entrance of the blade passage in order to minimize the rate of diffusion through the blade row for a given inlet and outlet condition. The final selection of the design blade shape parameters is based on optimizing each element of each blade row for the above considerations.

Rotors. - The inlet relative Mach numbers for all four rotors vary from about 1.48 at the tip to about 1.13 at the hub (fig. 2(e)). The radial distributions of the rotor-blade geometry parameters are presented in figure 13. All rotor configurations have a tip solidity of 1.3 (fig. 13(a)). The aerodynamic chord at the tip is about 5.6 centimeters for the low-aspect-ratio rotors and about 4.24 centimeters for the high-aspect-ratio rotors (fig. 13(b)). The incidence angle (fig. 13(c)) and front camber (fig. 13(d)) were selected such that the ratio of the area upstream of the blade leading edge to the area at the first captured Mach wave was sufficient to pass the mass flow. The leading-edge suction-surface incidence angles for rotors 36, 37, and 38 are about 2.7° at the tip, vary nearly linearly to zero at about 55 percent span from the tip, and remain zero to the hub. For rotor 35 the tip leading-edge incidence angle is about 2.7°, varies nearly linearly to a value of 1° at approximately 38 percent span from the tip, and then varies from 1° to about 0.5° at the hub. Radial distributions of deviation angle for all four rotors are presented in figure 13(e). The deviation angles were calculated based on a modified Carter's rule.

The selection of maximum thickness to chord ratio was based on a desire to have thin blades for aerodynamic considerations and yet have sufficient thickness to insure manufacturing tolerance acceptability and structural integrity. It was also desirable to avoid the use of midspan dampers. The maximum thickness to chord ratio for all four rotors is 8 percent at the hub (fig. 13(g)). The tip values are 3.2 percent for rotors 35 and 37 and 3.6 percent for rotors 36 and 38. The maximum thickness locations were selected to obtain a small leading-edge wedge angle and to avoid reverse camber on the pressure surface of the rotor blades. The locations of maximum thickness as a fraction of chord are 0.68 at the tip and approximately 0.52 at the hub (fig. 13(h)). The transition locations were selected to be near but aft of the approximate shock location (fig. 13(i)).

The blade throat location is defined as the location within the blade passage where the ratio of the local passage area to the critical area (A/A*) is minimum. The choke margin is defined as the percent of throat area ratio (A/A*) above unity. The choke margins for these rotors range from approximately 3 to 6 percent (fig. 13(j)).

Blade-element profiles for rotor 37 are shown in figure 14 for the tip, mean, and hub streamlines. The profiles are typical of those for the corresponding streamlines for rotors 35, 36, and 38. Blade manufacturing coordinates are presented in appendix C for all blade rows.

Stators. - The radial distributions of the stator geometry parameters are presented in figure 15. All of the stator blades have MCA profiles. The radial distributions of turn-rate ratio for the four stators are shown in figure 15(a). Turn-rate ratio is the ratio of the rate of angle change per unit distance for the front blade segment to that for the aft segment. A value of unity indicates a circular arc meanline, and a value less than unity indicates lower meanline curvature on the front segment of the blade. The radial distributions of turn-rate ratio are identical for all four stator designs (fig. 15(a)). These distributions indicate that the front camber is lowest in the hub region of the blade. The objective of this is to reduce the front camber in the region of the blade where the endwall problem is most severe and the inlet Mach number is high.

The radial distributions of solidity are shown in figure 15(b) for all four stators. The solidity is essentially the same for all four configurations and varies from 1.3 at the tip to roughly 1.47 at the hub. The radial distributions of aerodynamic chord are shown in figure 15(c). The aspect ratio is 1.78 for stators 36 and 38 and 1.26 for stators 35 and 37. The low-aspect ratio stators have 46 blades and the high-aspect-ratio stators have 62 blades.

The suction-surface - incidence-angle distributions (fig. 15(d)) are identical for all four configurations. The incidence angle varies from -3.0° at the tip to zero at the hub. This variation was chosen because of the variation in absolute-flow angle at the rotor outlet at off-design operating conditions. The variation in rotor-exit absolute-flow angle is relatively small in the hub region but extremely large in the tip region. As the mass flow is reduced, the rotor-outlet absolute flow angle increases, with increases in the tip region being much greater than in the hub region. Thus, the negative design stator-incidence angles in the tip region result in lower positive stator-incidence angles at the lower mass flows.

The throat location for all of the stators occurs at the entrance region of the blades. Examination of figure 15(j) shows that the choke margins for all four stators are excessive; however, this was not expected to be detrimental to stator performance.

MECHANICAL DESIGN

The basic approach used to achieve structural integrity for the blades in the mechanical design process was to limit the maximum combined (equivalent) stresses at high speed and avoid designs where the first mode bending resonance curve intersects the two-excitations-per-revolution curve. The maximum combined stresses were calculated for all blade rows at 120 percent design speed. The combined stresses for the rotors were minimized by stacking the blades so that their bending moments due to steady-state aerodynamic forces were balanced by centrifugal forces. The combined maximum stress, bending, and torsion reduced frequency flutter parameters, along with other design information are presented in table II for all blade rows. The maximum stresses for the stators are relatively low. The Campbell diagrams for rotors 35, 36, 37, and 38 are shown in figure 16. The purpose of the Campbell diagram is to avoid a design that would require continuous running at any speed in which a first- or second-mode bending frequency is the same as that for two or four excitations per revolution. Examination of the Campbell diagrams for the four rotors shows that the first mode bending curve intersects the four-excitations-per-revolution curve at 15 400 rpm for rotor 35, at 11 000 rpm for rotor 36, at 14 500 rpm for rotor 37, and at 12 500 rpm for rotor 38.

APPARATUS AND PROCEDURE

Compressor Test Facility

The compressor stages were tested in the Lewis single-stage compressor facility, which is described in detail in reference 5. A schematic diagram of the facility is shown in figure 17. Atmospheric air enters the facility at an inlet on the roof of the building and flows through the flow-measuring orifice and into the plenum chamber upstream of the test stage. The air passes through the experimental compressor stage into the collector and the vacuum exhaust system.

Test Stages

Photographs of the blade rows for the stages are presented in figure 18. The rotors with low aspect ratio (35 and 37) have 36 blades, and those with high aspect ratio (36 and 38) have 48 blades. The low-aspect-ratio stators (35 and 37) have 46 blades, and the high-aspect-ratio stators (36 and 38) have 62 blades. The stators are mounted in the outer casing as shown in figure 18.

Instrumentation

The mass flow was determined from measurements on a calibrated thin-plate orifice. The orifice temperature was obtained from an average of two Chromel-constantan thermocouples. Orifice pressures were measured by calibrated transducers. An electronic speed counter, in conjunction with a magnetic pickup, was used to measure rotative speed.

Radial surveys of flow conditions at station 1 (upstream of rotor) were made using two combination probes (fig. 19(a)) and two 18° wedge probes (fig. 19(b)). The combination probe measures total temperature, total pressure, and flow angle. The wedge probe measures static pressure and flow angle. Each probe was equipped with a null-balancing control system which automatically alined the probe with the flow direction. Chromel-constantan thermocouples were used to measure temperature. Inner- and outer-wall static-pressure taps were located at the same axial stators as the survey probes. The circumferential locations of the survey probes along with inner- and outer-wall-static taps are shown in figure 20.

Because of the close spacing between the rotor and stator, no measurements were made between the rotor and stator. At station 3 (downstream of stator) two combination probes and two wedge probes were traversed both circumferentially and radially to obtain the distributions of pressure, temperature, and flow angle. The estimated errors in the data, based on inherent accuracies of the instrumentation and the recording system, are as follows:

Mass flow, kg/sec	±0.3
Rotative speed, rpm	±30
Flow angle, deg	±1.0
Temperature, K	±0.6
Rotor-inlet (station 1) total pressure, N/cm^2	±0.01
Rotor-inlet (station 1) static pressure, N/cm^2	±0.03
Stator-outlet (station 3) total pressure, N/cm^2	±0.17
Stator-outlet (station 3) static pressure, N/cm^2	±0.10

Test Procedure

The stage survey data were taken over a range of flows and speeds. For the 70, 90, and 100 percent of design speeds, data were recorded at five or more flows from maximum to near stll conditions. For 50, 60, and 80 percent of design speeds, data were recorded at the near-stall flow only. Data were taken at nine radial positions for each flow point.

At each radial position the two combination probes behind the stator were traversed circumferentially to nine locations across the stator gap. The wedge static probes were set at midgap because preliminary studies showed that the static pressure across the gap was essentially constant. The total pressure, temperature, and flow angle were recorded at each circumferential position at station 3. At the last circumferential position the pressure, temperature, and flow angle were also recorded at station 1. All probes were then traversed to the next radial position, and the circumferential traverse procedure was repeated.

Calculation Procedure

Measured total pressures, static pressures, and total temperatures were corrected for Mach number and streamline slope. These corrections were based on an average calibration for the type of instrument used. Orifice mass flow, rotative speed, total pressures, static pressures, and temperatures were all corrected to standard-day conditions based on the rotor-inlet condition.

The circumferential distribution of static pressure downstream of the stator was assumed to be constant for each radial position and equal to the midgap values. At each radial position, averaged values of the nine circumferential measurements of total pressure, total temperature, and flow angle downstream of the stator (station 3) were obtained in the following manner: The midgap static pressure was used with the local total pressure, total temperature, and flow angle to calculate the circumferential distributions of velocity, static density, and axial and tangential velocity components. These distributions were used in the circumferential mass-averaging process. The nine values of total temperature were mass averaged to obtain the circumferentially averaged stator-outlet total temperature. The ratio of the nine local total pressures to the rotor-inlet total pressure is taken and converted to corresponding isentropic temperature ratios. These ratios are mass averaged, and the resulting value is converted (through the isentropic temperature-ratio - pressure-ratio relation) to a mass-averaged total pressure ratio. The average absolute velocity is obtained from the midgap static pressure, average total pressure, and total temperature. The average tangential velocity component is calculated by mass averaging the local tangential velocity. The average absolute velocity and the tangential velocity component are used to calculate the average flow angle and the average axial velocity. This calculation is performed for each of the two sets of probes at station 3, and the results from each set of probes are averaged to obtain single, averaged, values of total pressure, total temperature, static pressure, and flow angle at each radial position. To obtain the overall performance, the radial distributions of total temperature and total pressure are averaged using a procedure that is similar to that used for averaging the circumferential distributions of these parameters.

Because of the close spacing between the rotor and stator, no instrumentation could be used at station 2. The values of pressure, temperature, and flow angle at this station were obtained as follows: At each radial position total pressure and total temperature were translated along design streamlines from station 3. The circumferentially mass-averaged total temperatures from station 3 were used for the total temperatures at station 2. The arithmetic mean of the three highest total pressure values from the circumferential distributions at station 3 were used for the total-pressures at station 2. The radial distributions of static pressure and flow angle were calculated based on continuity of mass flow and radial equilibrium. Measured airflow and rotative speed were inputs. Design values of streamline curvature, blockages, and entropy gradients were also used in the calculation.

RESULTS AND DISCUSSION

The results are presented herein in terms of overall performance parameters. Overall performance for individual rotors and stages are presented as well as comparisons of the individual performances in order to evaluate the separate effects of varying both pressure ratio and aspect ratio. Overall performance data are presented over a range of flows at 70, 90, and 100 percent of design speeds. The near-stall flow points are presented at 50, 60, and 80 percent of design speeds. Overall performance data are presented in tubular form in tables III to VI.

Overall Performance

Stage 35. - The rotor and stage overall performances are shown in figure 21. At design speed the rotor and stage achieved peak efficiencies of 0.872 and 0.845, respectively, at a mass flow of 20.82 kilograms per second. The rotor and stage pressure ratios at peak efficiency conditions were 1.875 and 1.842, respectively. The design rotor and stage pressure ratios were 1.865 and 1.82, respectively. The mass flow at which peak efficiency occurred is about 3 percent higher than the design flow. At the design flow rate the rotor and stage pressure ratios exceeded the design value, but the efficiencies were somewhat lower than design. The maximum measured rotor efficiency of 0.905 occurred at 70 percent of design speed.

This low-pressure-ratio - low-aspect-ratio stage exhibits good stall margin. At design speed the stall margin is 21.8 percent based on conditions at stall and peak efficiency. At all speeds stage peak efficiency occurred near the point of maximum mass flow, thus providing good stall margin at all speeds.

Stage 36. - The rotor and stage overall performances are presented in figure 22. At design speed the rotor and stage achieved peak efficiencies of 0.852 and 0.821, respectively. The rotor peak efficiency occurred at the maximum flow (20.94 kg/sec) and a pressure ratio of 1.766. The stage peak efficiency occurred at a flow rate of 20.83 kilograms per second and a pressure ratio of 1.817. The design rotor and stage pressure ratios are 1.863 and 1.82, respectively. The mass flow at which rotor peak efficiency occurred is about 3 percent higher than design. The stage stalled at about the design mass flow but at a pressure ratio higher than the design value. The peak rotor efficiencies at 70 and 90 percent of design speeds were 0.912 and 0.892, respectively. The stage exhibits reasonably good stall margin at 70 and 90 percent of design speeds, but only about 11 percent at design speed.

Stage 37. - The rotor and stage overall performances are presented in figure 23. At design speed the rotor and stage achieved peak efficiencies of 0.876 and 0.840, respectively, at a mass flow rate of 20.74 kilograms per second. The rotor and stage pressure ratios at the peak efficiency conditions were 2.056 and 2.00, respectively. The design rotor and stage pressure ratios were 2.106 and 2.05, respectively. The mass flow rate at which peak efficiency occurred is about 3 percent higher than the design value. As was the case for stage 35, the rotor and stage pressure ratios at design flow rate exceeded design values, but the efficiencies were somewhat lower than design. The peak rotor efficiencies at 70 and 90 percent speeds were 0.932 and 0.915, respectively. The stage exhibits good stall margin (based on conditions at stall and peak efficiency) at 70 and 90 percent of design speed, but the stall margin at design speed is only 10 percent.

Stage 38. - The rotor and stage overall performances are presented in figure 24. At design speed the rotor and stage achieved peak efficiencies of 0.849 and 0.831, respectively. For both rotor and stage the peak efficiency occurred near the minimum flow conditions. The rotor and stage pressure ratios at the peak efficiency conditions were 1.969 and 1.944, respectively. The design values of rotor and stage pressure ratio are 2.105 and 2.05. The stage stall point and peak efficiency occurred at a mass flow higher than the design value at a pressure ratio less than the design value. The peak rotor efficiencies at 70 and 90 percent speeds were 0.949 and 0.901, respectively. The stage had little stall margin at all speeds tested.

Effects of Design Pressure Ratio Level on Overall Performance

A comparison of rotor and stage overall performances for the low-aspect-ratio configurations (stages 35 and 37) is presented in figure 25. (The design conditions are represented by the solid symbols.) The design pressure ratios for stages 35 and 37 are 1.82 and 2.05. The flow range for any given speed is larger for the low-pressure-ratio design (stage 35). However, over the operating range of the high-pressure ratio stage (37), a higher efficiency was obtained for a given flow at both 70 and 90 percent of design speeds. At design speed the efficiencies for the configurations are nearly equal. The stage stall lines for the two configurations are identical; however, the calculated stall margin at design speed is larger for the low-pressure-ratio configuration (stage 35).

Comparison plots of efficiency as a function of pressure ratio are presented in figure 26 for both rotor and stage for the two low-aspect-ratio configurations. These plots present a very interesting trend. For most values of pressure ratio, the high-pressure-ratio configuration (37) has the higher efficiency. At 90 percent of design speed rotor 37 achieved an efficiency of 0.905 at a pressure ratio of 1.855, which is very near the design pressure ratio for rotor 35.

Stall margin is plotted as a function of stage pressure ratio for stages 35 and 37 in figure 27. At pressure ratios up to 1.80, both stages exhibit adequate stall margin (17.5% and greater), but, stage 35 has a larger stall margin over its entire pressure ratio range. For the low-aspect-ratio designs the low-pressure-ratio configuration has greater stall margin.

Comparisons of rotor and stage overall performance for the high-aspect-ratio configurations (stages 36 and 38) are presented in figure 28. The design conditions are represented by solid symbols. The design pressure ratios for stages 36 and 38 are 1.82 and 2.05, respectively. At design speed the flow ranges are approximately the same for both configurations. At both 70 and 90 percent of design speed the flow range for the low-pressure-ratio configuration is somewhat larger than that for the high-pressure-ratio configuration. However, for the same mass flow the high-pressure-ratio configuration has the higher efficiency at these lower speeds. At design speed both the flow range and efficiency are approximately the same for both of the rotors and stages. The stage stall lines are nearly the same up to 90 percent design speed.

Comparison plots of efficiency as a function of total-pressure ratio are presented in figure 29 for both rotors and stages for the high-aspect-ratio configurations. These figures show that for most pressure ratios, the high-pressure-ratio configuration has a higher efficiency than the low-pressure-ratio configuration at both 70 and 90 percent of design speeds; however, at design speed both rotor and stage efficiencies are essentially the same for both configurations, showing little variation with pressure ratio.

Effects of Aspect Ratio on Overall Performance

To evaluate the effects of a change in aspect ratio, a comparison of rotor and stage overall performance is made for the configurations having the same design pressure ratio. The effects of aspect ratio on overall performance for the high-pressure-ratio stages is shown in figure 30. The low-aspect-ratio rotor and stage (37) achieved a higher peak pressure ratio and a larger flow range for the three speeds tested, with the largest increase occurring at the design speed. At design speed the rotor peak efficiency for the low-aspect-ratio configuration is about 2.5 points higher than that for the high-aspect-ratio configuration. At 90 and 70 percent of design speeds the trend is the same, but the difference in efficiency is about $1\frac{1}{2}$ points. The stage efficiencies for these two configurations are much closer. There is a significant difference in the stage stall line for the two stages from 70 to 100 percent of design speed. At design speed the stall margin for the low-aspect-ratio stage (37) is approximately 11 percent; it is only 3 percent for the high-aspect-ratio stage (38).

Similar trends are shown for the low-pressure-ratio stages (35 and 36, fig. 31). The low-aspect-ratio stage has greater range and a higher peak pressure ratio than the high-aspect-ratio stage. At design speed the peak efficiency for both rotor and stage is roughly 2 points higher for the low-aspect-ratio configuration. At 70 and 90 percent of design speeds the efficiencies are about the same for both rotors and stages. There is a significant difference in the stage stall lines from 70 to 100 percent design speed for the two configurations (fig. 31(b)). At design speed the stall margin for the low-aspec-ratio configuration is approximately 20 percent, while it is only 7 percent for the high-aspect-ratio configuration.

For both levels of pressure ratio, the overall performances of the low-aspect-ratio-configurations are substantially better than those of the higher aspect ratio configurations.

SUMMARY OF RESULTS

This report has presented the design and overall performances of four inlet stages for an advanced core compressor. Rotor solidity, stator solidity, rotative speed, mass flow, and flow-path geometry were the same for all four configurations. The basic overall design variations were stage pressure ratio and blade-row aspect ratio. These four stages represent two levels of total-pressure ratio (1.82 and 2.05), two levels of rotor aspect ratios (1.19 and 1.63) and two levels of stator aspect ratio (1.26 and 1.78). Comparisons of radial distributions of blade shape parameters were made for all rotor and stator blade rows. The similarity of these distributions are indicative of the fact that the blade profiles are quite similar.

All stages were tested over the stable operating flow range at 70, 90, and 100 percent of design speed. The measured values of peak efficiencies, total pressure ratios, and stall margins, for all four configurations are presented in the following summary chart for design speed.

Stage number	Rotor aspect ratio	Rotor peak efficiency	Stage peak efficiency	Rotor pressure ratio	Stage pressure ratio	Stall margin
37	1.19	0.876	0.840	2.056	2.000	10
35	1.19	.872	.845	1.875	1.842	21
36	1.63	.852	.821	1.766	1.730	11
38	1.63	.849	.831	1.969	1.944	0

1. The overall performances for the low-aspect-ratio configurations were substantially better than those for the high-aspect-ratio configurations.

2. Both low-aspect-ratio configurations achieved about the same peak efficiency at design speed, but the higher pressure ratio configuration achieved the higher peak efficiencies at 70 and 90 percent of design speed. However, the lower pressure ratio configuration has the largest stall margin at all speeds tested.

3. For the high-aspect-ratio configurations the higher pressure ratio stage had higher rotor and stage peak efficiencies at all speeds tested. However, both of these configurations have practically no stall margin at design speed.

Lewis Research Center,
National Aeronautics and Space Administration,
Cleveland, Ohio, June 21, 1978,
505-04.

APPENDIX A

SYMBOLS

ΔA	incremental annulus area, m^2
A_{an}	annulus area at rotor leading edge, m^2
A_f	frontal area at rotor leading edge, m^2
A/A^*	critical area
$(A/A^*)_{th}$	throat area ratio
C	change in blade angle per unit path distance (dk/ds), cm^{-1}
C_p	specific heat at constant pressure, 1004 J/(kg)(K)
c	aerodynamic chord, cm
D	diffusion factor
H	height (normal to chordwise direction) coordinate on blade section, cm
i_{ss}	suction-surface incidence angle, angle between inlet air direction and line tangent to blade suction surface at leading edge, deg
K	local blade angle with respect meridional direction, deg
L	length (chordwise direction) coordinate on blade section, cm
N	rotative speed, rpm
NR	number of radial locations where measurements of flow conditions are made
n	coordinate in tangential direction, cm
P	total pressure, N/cm^2
p	static pressure, N/cm^2
R	radial coordinate on blade-element layout cone, cm
r	radius, cm
S	path distance on blade-element layout cone, cm
SM	stall margin
T	total temperature, K
U	wheel speed, m/sec
V	velocity, m/sec
W	mass flow, kg/sec

X	blade section coordinate in chordwise direction, cm
Y	blade section coordinate normal to chordwise direction, cm
Z	axial distance references from rotor blade hub leading edge, cm
z	axial coordinate in cylindrical coordinate system, cm
α_c	cone angle, deg
α_s	slope of streamline, deg
β	air angle, angle between air velocity and axial direction, deg
β_c'	relative meridional flow angle based on cone angle, $\arctan(\tan \beta_m' \cos \alpha_c/\cos \alpha_s)$, deg
γ	ratio of specific heats (1.40)
δ	ratio of rotor-inlet total pressure to standard pressure of 10.13 Pa
δ^o	deviation angle, angle between exit-air direction and tangent to blade mean camber line at trailing edge, deg
ϵ	angular coordinate on blade-element layout cone, deg
η	efficiency
θ	ratio of rotor-inlet total temperature to standard temperature of 288.2 K
κ_{mc}	angle between the blade mean camber line and the meridional plane, deg
κ_{ss}	angle between the blade suction-surface camber line at the leading edge and the meridional plane, deg
ρ	density, kg/sec
σ	solidity, ratio of chord to spacing
φ	blade camber, deg
$\overline{\omega}$	total-loss coefficient
$\overline{\omega}_p$	profile-loss coefficient
$\overline{\omega}_s$	shock-loss coefficient

Subscripts:

a	aft blade segment
ad	adiabatic
c	blade-element centerline on layout cone
ca	blade section center of area

e	blade element
f	front
h	hub
id	ideal
le	blade leading edge
m	maximum thickness point and also meridional direction
mc	blade mean line
mom	momentum rise
p	polytropic
sp	blade section stacking point
ss	suction surface
t	transition point, and tip
te	blade trailing edge
th	throat
z	axial direction
θ	tangential direction
1	instrumentation plane upstream of rotor
2	instrumentation plane between rotor and stator
3	instrumentation plane downstream of stator

Superscript:

'	relative to blade

APPENDIX B

EQUATIONS

Suction surface incidence angle -

$$i_{ss} = \left(\beta'_c\right)_{le} - \kappa_{ss} \tag{B1}$$

Deviation angle -

$$\delta^o = \left(\beta'_c\right)_{te} - \left(\kappa_{mc}\right)_{te} \tag{B2}$$

Front suction-surface camber -

$$\varphi_{f,ss} = \left(\kappa_{ss}\right)_{le} - \left(\kappa_{ss}\right)_t \tag{B3}$$

Total camber -

$$\varphi_t = \left(\kappa_{mc}\right)_{le} - \left(\kappa_{mc}\right)_{te} \tag{B4}$$

Turn rate ratio -

$$(C_f/C_a) \tag{B5}$$

Choke margin -

$$(A/A^* - 1.0)_{minimum} \tag{B6}$$

Diffusion factor -

$$D = 1 - \frac{V'_{te}}{V'_{le}} + \left|\frac{\left(rV_\theta\right)_{te} - \left(rV_\theta\right)_{le}}{(r_{te} + r_{le})\sigma(V'_{le})}\right| \tag{B7}$$

Total-loss coefficient -

$$\overline{\omega} = \frac{\left(P'_{id}\right)_{te} - (P')_{te}}{(P')_{te} - (p)_{te}} \tag{B8}$$

Profile-loss coefficient -

$$\overline{\omega}_p = \overline{\omega} - \overline{\omega}_s \tag{B9}$$

Total-loss parameter -

$$\frac{\overline{\omega} \cos\left(\beta'_m\right)_{te}}{2\sigma} \tag{B10}$$

Profile-loss parameter -

$$\frac{\overline{\omega}_p \cos\left(\beta'_m\right)_{te}}{2\sigma} \tag{B11}$$

Rotor total-pressure ratio -

$$\left(\overline{P_2/P_1}\right) = \left[\frac{\int_{r_h}^{r_t} (P_2/P_1)^{(\gamma-1)/\gamma} \rho v_z \, r \, dr}{\int_{r_h}^{r_t} \rho v_z \, r \, dr}\right]^{\gamma/(\gamma-1)}$$

$$= \left[\frac{\sum_{i=1}^{NR} \left(P_2/P_1\right)_i^{(\gamma-1)/\gamma} \rho_{2,i} V_{z2,i} \Delta A_{2,i}}{\sum_{i=1}^{NR} \rho_{2,i} V_{z2,i} \Delta A_{2,i}}\right]^{\gamma/(\gamma-1)} \tag{B12}$$

Stage total-pressure ratio -

$$\left(\overline{P_3/P_1}\right) = \left[\frac{\displaystyle\int_{r_h}^{r_t} (P_3/P_1)^{(\gamma-1)/\gamma} \rho v_z \, r \, dr}{\displaystyle\int_{r_n}^{r_t} \rho v_z \, r \, dr}\right]^{\gamma/(\gamma-1)}$$

$$= \left[\frac{\displaystyle\sum_{i=1}^{NR} \left(P_3/P_1\right)_i^{(\gamma-1)/\gamma} \rho_{3,i} V_{z3,i} \Delta A_{3,i}}{\displaystyle\sum_{i=1}^{NR} \rho_{3,i} V_{z3,i} \Delta A_{3,i}}\right]^{\gamma/(\gamma-1)} \qquad \text{(B13)}$$

Total-temperature ratio -

$$\left(\overline{T_2/T_1}\right) = \frac{\displaystyle\int_{r_h}^{r_t} (T_2/T_1) \rho v_z \, r \, dr}{\displaystyle\int_{r_n}^{r_t} \rho v_z \, r \, dr} = \frac{\displaystyle\sum_{i=1}^{NR} \left(T_2/T_1\right)_i \rho_{2,i} V_{z2,i} \Delta A_{2,i}}{\displaystyle\sum_{i=1}^{NR} \rho_{2,i} V_{z2,i} \Delta A_{2,i}} \qquad \text{(B14)}$$

Rotor adiabatic efficiency -

$$\eta_{ad} = \frac{\left(\overline{P_2/P_1}\right)^{(\gamma-1)/\gamma} - 1}{\left(\overline{T_2/T_1}\right) - 1} \qquad \text{(B15)}$$

Stage adiabatic efficiency -

$$\eta_{ad} = \frac{\left(\overline{P_3/P_1}\right)^{(\gamma-1)/\gamma} - 1}{\left(\overline{T_3/T_1}\right) - 1} \tag{B16}$$

Rotor-inlet mass averaged temperature -

$$\overline{T}_1 = \frac{\int_{r_h}^{r_t} T_1 \rho v_z \, r \, dr}{\int_{r_h}^{r_t} \rho v_z \, r \, dr} = \frac{\sum_{i=1}^{NR} T_{1,i} \, \rho_{1,i} \, V_{z1,i} \, \Delta A_{1,i}}{\sum_{i=1}^{NR} \rho_{1,i} \, V_{z1,i} \, \Delta A_{1,i}} \tag{B17}$$

Momentum-rise efficiency -

$$\eta_{mom} = \frac{\left(\overline{P_2/P_1}\right)^{(\gamma-1)/\gamma} - 1}{\dfrac{\int_{r_n}^{r_t} \left[\left(UV_\theta\right)_2 - \left(UV_\theta\right)_1\right] \rho v_z \, r \, dr}{\overline{T}_1 \, C_p}}$$

$$= \frac{\left(\overline{P_2/P_1}\right)^{(\gamma-1)/\gamma} - 1}{\dfrac{\sum_{i=1}^{NR} \left[\left(UV_\theta\right)_2 - \left(UV_\theta\right)_1\right]_1 \rho_{2,i} \, V_{z2,i} \, \Delta A_{2,i}}{\overline{T}_1 \, C_p}} \tag{B18}$$

Head rise coefficient -

$$\frac{C_p \overline{T}_1}{U_t^2}\left[\left(\overline{P_2/P_1}\right)^{(\gamma-1)/\gamma} - 1\right] \tag{B19}$$

Equivalent mass flow -

$$\frac{W\sqrt{\theta}}{\delta} \tag{B20}$$

Equivalent speed -

$$\frac{N}{\sqrt{\theta}} \tag{B21}$$

Mass flow per unit annulus area -

$$\frac{\dfrac{W\sqrt{\theta}}{\delta}}{A_{an}} \tag{B22}$$

Mass flow per unit frontal area -

$$\frac{\dfrac{W\sqrt{\theta}}{\delta}}{A_f} \tag{B23}$$

Flow coefficient -

$$\left(\frac{V_z}{U_t}\right)_{LE} \tag{B24}$$

Stall margin -

$$SM = \left[\frac{\left(\overline{P_3/P_1}\right)_{stall} \times \left(\dfrac{W\sqrt{\theta}}{\delta}\right)_{ref}}{\left(\overline{P_3/P_1}\right)_{ref} \times \left(\dfrac{W\sqrt{\theta}}{\delta}\right)_{stall}} - 1\right] \times 100 \tag{B25}$$

Rotor polytropic efficiency -

$$\eta_p = \frac{\ln\left(\overline{P_2/P_1}\right)^{(\gamma-1)/\gamma}}{\ln\left(\overline{T_2/T_1}\right)} \tag{B26}$$

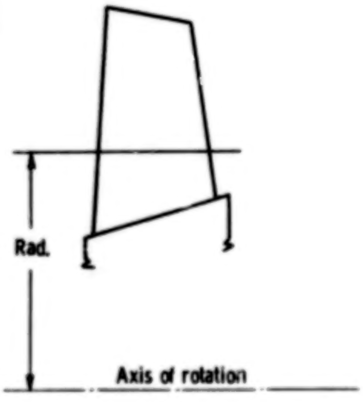
Stage polytropic efficiency -

$$\eta_p = \frac{\ln\left(\overline{P_3/P_1}\right)^{(\gamma-1)/\gamma}}{\ln\left(\overline{T_3/T_1}\right)} \tag{B27}$$

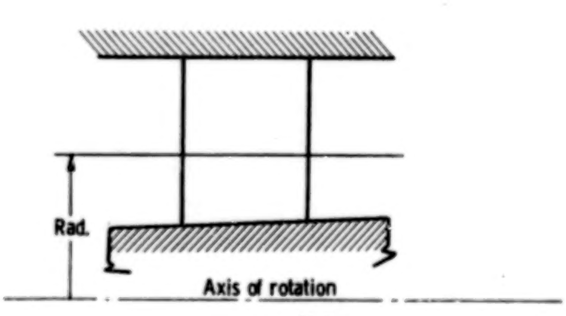
APPENDIX C

BLADE MANUFACTURING COORDINATES

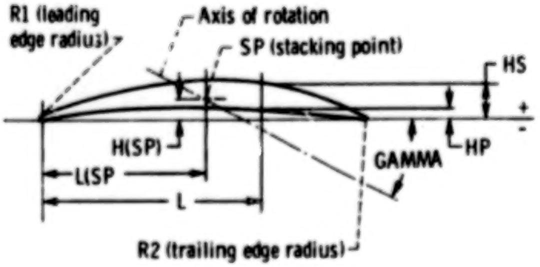
This appendix provides blade manufacturing coordinates for all four stages. The necessary blade nomenclature is provided in sufficient detail to describe the coordinate system. The coordinates in this appendix are in inches because at present all tooling used for blade fabrication by American companies utilizes the U.S. customary system of units.


Rad.
Axis of rotation

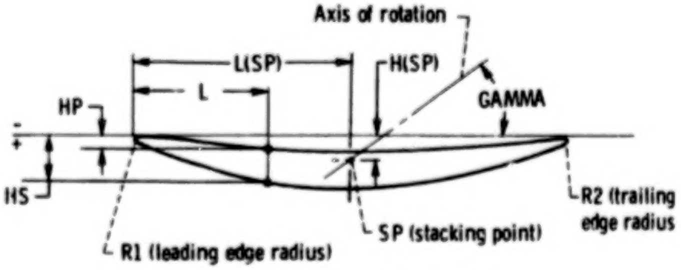
Rotor


Rad.
Axis of rotation

Stator


R1 (leading edge radius)
Axis of rotation
SP (stacking point)
HS
+
-
H(SP)
HP
L(SP
GAMMA
L
R2 (trailing edge radius)

Nomenclature for rotor-blade section coordinates.


Axis of rotation
L(SP)
H(SP)
GAMMA
HP
L
-
+
HS
R2 (trailing edge radius
SP (stacking point)
R1 (leading edge radius)

Nomenclature for stator-blade section coordinates.

BLADE MANUFACTURING COORDINATES FOR ROTOR 35

RAD = 7.0000 INCHES	RAD = 7.2000 INCHES	RAD = 7.4700 INCHES
R_1 = 0.0099 INCHES	R_1 = 0.0096 INCHES	R_1 = 0.0091 INCHES
R_2 = 0.0116 INCHES	R_2 = 0.0109 INCHES	R_2 = 0.0101 INCHES
$L_{(SP)}$ = 1.1177 INCHES	$L_{(SP)}$ = 1.1191 INCHES	$L_{(SP)}$ = 1.1202 INCHES
$H_{(SP)}$ = 0.1490 INCHES	$H_{(SP)}$ = 0.1245 INCHES	$H_{(SP)}$ = 0.0972 INCHES
GAMMA = 39 DEG 39 MIN	GAMMA = 41 DEG 22 MIN	GAMMA = 43 DEG 39 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0099	0.0099	0.0000	0.0096	0.0096	0.0000	0.0091	0.0091
0.1000	0.0076	0.0522	0.1000	0.0060	0.0481	0.1000	0.0040	0.0432
0.2000	0.0161	0.0852	0.2000	0.0126	0.0775	0.2000	0.0083	0.0685
0.3000	0.0246	0.1161	0.3000	0.0191	0.1049	0.3000	0.0124	0.0918
0.4000	0.0332	0.1448	0.4000	0.0256	0.1302	0.4000	0.0166	0.1132
0.5000	0.0418	0.1712	0.5000	0.0321	0.1533	0.5000	0.0206	0.1326
0.6000	0.0505	0.1955	0.6000	0.0386	0.1744	0.6000	0.0246	0.1501
0.7000	0.0593	0.2180	0.7000	0.0450	0.1935	0.7000	0.0285	0.1657
0.8000	0.0684	0.2380	0.8000	0.0514	0.2105	0.8000	0.0324	0.1793
0.9000	0.0775	0.2550	0.9000	0.0581	0.2254	0.9000	0.0362	0.1910
1.0000	0.0856	0.2685	1.0000	0.0644	0.2373	1.0000	0.0398	0.2006
1.1000	0.0922	0.2777	1.1000	0.0688	0.2452	1.1000	0.0430	0.2072
1.2000	0.0968	0.2824	1.2000	0.0720	0.2488	1.2000	0.0450	0.2099
1.3000	0.0993	0.2824	1.3000	0.0737	0.2481	1.3000	0.0458	0.2088
1.4000	0.0996	0.2775	1.4000	0.0737	0.2430	1.4000	0.0456	0.2040
1.5000	0.0974	0.2674	1.5000	0.0718	0.2333	1.5000	0.0442	0.1952
1.6000	0.0926	0.2517	1.6000	0.0679	0.2188	1.6000	0.0416	0.1825
1.7000	0.0848	0.2298	1.7000	0.0619	0.1991	1.7000	0.0377	0.1655
1.8000	0.0735	0.2011	1.8000	0.0535	0.1737	1.8000	0.0324	0.1442
1.9000	0.0584	0.1645	1.9000	0.0425	0.1421	1.9000	0.0258	0.1181
2.0000	0.0387	0.1183	2.0000	0.0287	0.1033	2.0000	0.0176	0.0870
2.1000	0.0136	0.0596	2.1000	0.0115	0.0559	2.1000	0.0078	0.0503
2.1593	0.0116	0.0116	2.1693	0.0109	0.0109	2.1798	0.0101	0.0101

ROTOR 35 - Continued

RAD = 7.7500 INCHES

R_1 = 0.0086 INCHES
R_2 = 0.0093 INCHES

$L_{(SP)}$ = 1.1220 INCHES
$H_{(SP)}$ = 0.0752 INCHES
GAMMA = 45 DEG 56 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0086	0.0086
0.1000	0.0024	0.0388
0.2000	0.0048	0.0603
0.3000	0.0071	0.0801
0.4000	0.0093	0.0981
0.5000	0.0115	0.1144
0.6000	0.0136	0.1290
0.7000	0.0156	0.1418
0.8000	0.0176	0.1528
0.9000	0.0195	0.1622
1.0000	0.0215	0.1699
1.1000	0.0231	0.1750
1.2000	0.0241	0.1772
1.3000	0.0246	0.1762
1.4000	0.0245	0.1719
1.5000	0.0236	0.1642
1.6000	0.0220	0.1532
1.7000	0.0198	0.1388
1.8000	0.0169	0.1209
1.9000	0.0133	0.0993
2.0000	0.0091	0.0740
2.1000	0.0042	0.0448
2.1872	0.0093	0.0093

RAD = 8.0000 INCHES

R_1 = 0.0082 INCHES
R_2 = 0.0087 INCHES

$L_{(SP)}$ = 1.1255 INCHES
$H_{(SP)}$ = 0.0611 INCHES
GAMMA = 47 DEG 56 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0082	0.0082
0.1000	0.0021	0.0355
0.2000	0.0040	0.0545
0.3000	0.0057	0.0719
0.4000	0.0072	0.0878
0.5000	0.0084	0.1020
0.6000	0.0095	0.1147
0.7000	0.0105	0.1258
0.8000	0.0114	0.1354
0.9000	0.0119	0.1432
1.0000	0.0123	0.1494
1.1000	0.0132	0.1542
1.2000	0.0135	0.1560
1.3000	0.0132	0.1546
1.4000	0.0127	0.1504
1.5000	0.0119	0.1435
1.6000	0.0109	0.1336
1.7000	0.0095	0.1209
1.8000	0.0079	0.1052
1.9000	0.0061	0.0866
2.0000	0.0041	0.0649
2.1000	0.0019	0.0403
2.1907	0.0087	0.0087

RAD = 8.2500 INCHES

R_1 = 0.0078 INCHES
R_2 = 0.0081 INCHES

$L_{(SP)}$ = 1.1338 INCHES
$H_{(SP)}$ = 0.0527 INCHES
GAMMA = 50 DEG 17 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0078	0.0078
0.1000	0.0014	0.0318
0.2000	0.0027	0.0480
0.3000	0.0039	0.0630
0.4000	0.0049	0.0768
0.5000	0.0058	0.0894
0.6000	0.0066	0.1007
0.7000	0.0073	0.1108
0.8000	0.0078	0.1196
0.9000	0.0086	0.1275
1.0000	0.0094	0.1345
1.1000	0.0095	0.1389
1.2000	0.0095	0.1412
1.3000	0.0096	0.1409
1.4000	0.0092	0.1378
1.5000	0.0085	0.1319
1.6000	0.0076	0.1230
1.7000	0.0066	0.1115
1.8000	0.0054	0.0972
1.9000	0.0041	0.0801
2.0000	0.0027	0.0602
2.1000	0.0012	0.0374
2.1908	0.0081	0.0081

ROTOR 35 - Continued

RAD = 8.5000 INCHES

R_1 = 0.0074 INCHES
R_2 = 0.0075 INCHES

$L_{(SP)}$ = 1.1323 INCHES
$H_{(SP)}$ = 0.0421 INCHES
GAMMA = 52 DEG 25 MIN

RAD = 8.7500 INCHES

R_1 = 0.0070 INCHES
R_2 = 0.0068 INCHES

$L_{(SP)}$ = 1.1400 INCHES
$H_{(SP)}$ = 0.0338 INCHES
GAMMA = 54 DEG 31 MIN

RAD = 9.0000 INCHES

R_1 = 0.0065 INCHES
R_2 = 0.0062 INCHES

$L_{(SP)}$ = 1.1345 INCHES
$H_{(SP)}$ = 0.0257 INCHES
GAMMA = 56 DEG 10 MIN

L	HP	HS	L	HP	HS	L	HP	HS
INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
0.0000	0.0074	0.0074	0.0000	0.0070	0.0070	0.0000	0.0065	0.0065
0.1000	-0.0001	0.0282	0.1000	-0.0005	0.0251	0.1000	-0.0016	0.0223
0.2000	-0.0002	0.0416	0.2000	-0.0010	0.0363	0.2000	-0.0031	0.0316
0.3000	-0.0002	0.0541	0.3000	-0.0015	0.0468	0.3000	-0.0045	0.0404
0.4000	-0.0002	0.0656	0.4000	-0.0020	0.0565	0.4000	-0.0056	0.0485
0.5000	-0.0001	0.0762	0.5000	-0.0023	0.0655	0.5000	-0.0064	0.0561
0.6000	0.0001	0.0859	0.6000	-0.0025	0.0738	0.6000	-0.0070	0.0631
0.7000	0.0003	0.0947	0.7000	-0.0027	0.0813	0.7000	-0.0074	0.0696
0.8000	0.0007	0.1025	0.8000	-0.0026	0.0882	0.8000	-0.0075	0.0755
0.9000	0.0013	0.1097	0.9000	-0.0024	0.0943	0.9000	-0.0073	0.0809
1.0000	0.0020	0.1162	1.0000	-0.0019	0.0999	1.0000	-0.0066	0.0859
1.1000	0.0028	0.1210	1.1000	-0.0012	0.1049	1.1000	-0.0058	0.0903
1.2000	0.0036	0.1244	1.2000	-0.0003	0.1091	1.2000	-0.0046	0.0942
1.3000	0.0042	0.1252	1.3000	0.0004	0.1109	1.3000	-0.0030	0.0968
1.4000	0.0044	0.1231	1.4000	0.0009	0.1099	1.4000	-0.0020	0.0968
1.5000	0.0043	0.1184	1.5000	0.0012	0.1064	1.5000	-0.0010	0.0942
1.6000	0.0041	0.1109	1.6000	0.0013	0.1003	1.6000	-0.0004	0.0892
1.7000	0.0036	0.1008	1.7000	0.0013	0.0916	1.7000	0.0000	0.0818
1.8000	0.0030	0.0881	1.8000	0.0012	0.0804	1.8000	0.0002	0.0720
1.9000	0.0023	0.0728	1.9000	0.0011	0.0666	1.9000	0.0003	0.0600
2.0000	0.0015	0.0548	2.0000	0.0008	0.0503	2.0000	0.0003	0.0457
2.1000	0.0007	0.0342	2.1000	0.0004	0.0314	2.1000	0.0001	0.0293
2.1907	0.0075	0.0075	2.1895	0.0068	0.0068	2.1972	0.0062	0.0062

ROTOR 35 - Concluded

RAD = 9.2500 INCHES

R_1 = 0.0061 INCHES

R_2 = 0.0056 INCHES

$L_{(SP)}$ = 1.1245 INCHES

$H_{(SP)}$ = 0.0159 INCHES

GAMMA = 57 DEG 51 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0061	0.0061
0.1000	-0.0028	0.0197
0.2000	-0.0055	0.0272
0.3000	-0.0078	0.0342
0.4000	-0.0099	0.0407
0.5000	-0.0116	0.0467
0.6000	-0.0129	0.0523
0.7000	-0.0138	0.0573
0.8000	-0.0143	0.0620
0.9000	-0.0143	0.0662
1.0000	-0.0139	0.0700
1.1000	-0.0130	0.0735
1.2000	-0.0116	0.0769
1.3000	-0.0095	0.0794
1.4000	-0.0075	0.0806
1.5000	-0.0057	0.0795
1.6000	-0.0042	0.0760
1.7000	-0.0029	0.0704
1.8000	-0.0019	0.0626
1.9000	-0.0011	0.0526
2.0000	-0.0005	0.0404
2.1000	-0.0001	0.0259
2.1925	0.0056	0.0056

RAD = 9.6100 INCHES

R_1 = 0.0055 INCHES

R_2 = 0.0047 INCHES

$L_{(SP)}$ = 1.1194 INCHES

$H_{(SP)}$ = 0.0005 INCHES

GAMMA = 60 DEG 51 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0055	0.0055
0.1000	-0.0041	0.0156
0.2000	-0.0082	0.0201
0.3000	-0.0119	0.0242
0.4000	-0.0151	0.0279
0.5000	-0.0180	0.0313
0.6000	-0.0204	0.0344
0.7000	-0.0223	0.0372
0.8000	-0.0237	0.0397
0.9000	-0.0246	0.0421
1.0000	-0.0249	0.0443
1.1000	-0.0244	0.0465
1.2000	-0.0231	0.0486
1.3000	-0.0215	0.0508
1.4000	-0.0198	0.0531
1.5000	-0.0158	0.0554
1.6000	-0.0129	0.0561
1.7000	-0.0102	0.0539
1.8000	-0.0077	0.0494
1.9000	-0.0056	0.0428
2.0000	-0.0036	0.0340
2.1000	-0.0018	0.0229
2.2000	-0.0000	0.0097
2.2070	0.0047	0.0047

RAD = 9.9400 INCHES

R_1 = 0.0051 INCHES

R_2 = 0.0035 INCHES

$L_{(SP)}$ = 1.0983 INCHES

$H_{(SP)}$ = -0.0210 INCHES

GAMMA = 65 DEG 40 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0051	0.0051
0.1000	-0.0063	0.0102
0.2000	-0.0125	0.0098
0.3000	-0.0184	0.0093
0.4000	-0.0239	0.0086
0.5000	-0.0289	0.0079
0.6000	-0.0333	0.0071
0.7000	-0.0371	0.0065
0.8000	-0.0403	0.0060
0.9000	-0.0428	0.0058
1.0000	-0.0446	0.0058
1.1000	-0.0454	0.0066
1.2000	-0.0450	0.0084
1.3000	-0.0437	0.0109
1.4000	-0.0420	0.0136
1.5000	-0.0397	0.0162
1.6000	-0.0363	0.0188
1.7000	-0.0321	0.0212
1.8000	-0.0276	0.0224
1.9000	-0.0230	0.0214
2.0000	-0.0181	0.0188
2.1000	-0.0125	0.0151
2.2000	-0.0060	0.0108
2.2827	0.0035	0.0035

BLADE MANUFACTURING COORDINATES FOR STATOR 35

RAD	= 7.4100 INCHES	RAD	= 7.6000 INCHES	RAD	= 7.7500 INCHES
R_1	= 0.0045 INCHES	R_1	= 0.0046 INCHES	R_1	= 0.0046 INCHES
R_2	= 0.0045 INCHES	R_2	= 0.0045 INCHES	R_2	= 0.0046 INCHES
$L_{(SP)}$	= 0.7517 INCHES	$L_{(SP)}$	= 0.7607 INCHES	$L_{(SP)}$	= 0.7677 INCHES
$H_{(SP)}$	= 0.0910 INCHES	$H_{(SP)}$	= 0.0910 INCHES	$H_{(SP)}$	= 0.0911 INCHES
GAMMA	= 22 DEG 32 MIN	GAMMA	= 21 DEG 50 MIN	GAMMA	= 21 DEG 20 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0045	0.0045	0.0000	0.0046	0.0046	0.0000	0.0046	0.0046
0.0500	0.0095	0.0245	0.0500	0.0093	0.0250	0.0500	0.0091	0.0253
0.1000	0.0194	0.0401	0.1000	0.0189	0.0409	0.1000	0.0186	0.0416
0.1500	0.0287	0.0546	0.1500	0.0280	0.0557	0.1500	0.0274	0.0566
0.2000	0.0374	0.0680	0.2000	0.0364	0.0694	0.2000	0.0356	0.0705
0.2500	0.0454	0.0803	0.2500	0.0442	0.0820	0.2500	0.0432	0.0833
0.3000	0.0528	0.0916	0.3000	0.0513	0.0935	0.3000	0.0501	0.0949
0.3500	0.0595	0.1019	0.3500	0.0578	0.1039	0.3500	0.0564	0.1055
0.4000	0.0657	0.1111	0.4000	0.0636	0.1132	0.4000	0.0620	0.1150
0.4500	0.0712	0.1194	0.4500	0.0689	0.1216	0.4500	0.0671	0.1234
0.5000	0.0761	0.1267	0.5000	0.0735	0.1289	0.5000	0.0715	0.1307
0.5500	0.0803	0.1329	0.5500	0.0774	0.1351	0.5500	0.0752	0.1370
0.6000	0.0838	0.1379	0.6000	0.0807	0.1402	0.6000	0.0783	0.1421
0.6500	0.0865	0.1418	0.6500	0.0832	0.1440	0.6500	0.0806	0.1459
0.7000	0.0883	0.1443	0.7000	0.0849	0.1466	0.7000	0.0823	0.1485
0.7500	0.0893	0.1455	0.7500	0.0858	0.1479	0.7500	0.0832	0.1499
0.8000	0.0895	0.1455	0.8000	0.0860	0.1480	0.8000	0.0833	0.1501
0.8500	0.0888	0.1443	0.8500	0.0854	0.1468	0.8500	0.0827	0.1490
0.9000	0.0873	0.1417	0.9000	0.0839	0.1444	0.9000	0.0814	0.1467
0.9500	0.0849	0.1379	0.9500	0.0817	0.1407	0.9500	0.0793	0.1431
1.0000	0.0816	0.1328	1.0000	0.0787	0.1358	1.0000	0.0765	0.1383
1.0500	0.0774	0.1264	1.0500	0.0749	0.1296	1.0500	0.0729	0.1323
1.1000	0.0724	0.1187	1.1000	0.0702	0.1221	1.1000	0.0685	0.1249
1.1500	0.0664	0.1096	1.1500	0.0648	0.1133	1.1500	0.0634	0.1163
1.2000	0.0595	0.0992	1.2000	0.0584	0.1032	1.2000	0.0575	0.1064
1.2500	0.0517	0.0874	1.2500	0.0512	0.0917	1.2500	0.0508	0.0951
1.3000	0.0429	0.0741	1.3000	0.0432	0.0788	1.3000	0.0432	0.0825
1.3500	0.0331	0.0594	1.3500	0.0342	0.0645	1.3500	0.0349	0.0685
1.4000	0.0223	0.0432	1.4000	0.0244	0.0487	1.4000	0.0257	0.0531
1.4500	0.0105	0.0254	1.4500	0.0136	0.0315	1.4500	0.0157	0.0362
1.4963	0.0045	0.0045	1.5000	0.0019	0.0127	1.5000	0.0048	0.0178
			1.5128	0.0045	0.0045	1.5259	0.0046	0.0046

STATOR 35 - Continued

RAD = 8.0000 INCHES

R_1 = 0.0047 INCHES

R_2 = 0.0046 INCHES

$L_{(SP)}$ = 0.7792 INCHES

$H_{(SP)}$ = 0.0912 INCHES

GAMMA = 20 DEG 37 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0047	0.0047
0.0500	0.0087	0.0258
0.1000	0.0178	0.0425
0.1500	0.0262	0.0580
0.2000	0.0341	0.0722
0.2500	0.0413	0.0853
0.3000	0.0479	0.0973
0.3500	0.0538	0.1080
0.4000	0.0592	0.1177
0.4500	0.0639	0.1263
0.5000	0.0680	0.1338
0.5500	0.0715	0.1401
0.6000	0.0743	0.1453
0.6500	0.0765	0.1493
0.7000	0.0780	0.1520
0.7500	0.0788	0.1535
0.8000	0.0790	0.1538
0.8500	0.0785	0.1529
0.9000	0.0773	0.1508
0.9500	0.0755	0.1475
1.0000	0.0729	0.1429
1.0500	0.0697	0.1371
1.1000	0.0658	0.1300
1.1500	0.0612	0.1217
1.2000	0.0559	0.1121
1.2500	0.0498	0.1012
1.3000	0.0431	0.0889
1.3500	0.0356	0.0754
1.4000	0.0275	0.0604
1.4500	0.0185	0.0440
1.5000	0.0089	0.0262
1.5478	0.0046	0.0046

RAD = 8.2500 INCHES

R_1 = 0.0047 INCHES

R_2 = 0.0047 INCHES

$L_{(SP)}$ = 0.7904 INCHES

$H_{(SP)}$ = 0.0921 INCHES

GAMMA = 20 DEG 4 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0047	0.0047
0.0500	0.0083	0.0264
0.1000	0.0171	0.0436
0.1500	0.0252	0.0595
0.2000	0.0327	0.0742
0.2500	0.0396	0.0877
0.3000	0.0459	0.0999
0.3500	0.0516	0.1110
0.4000	0.0566	0.1210
0.4500	0.0611	0.1298
0.5000	0.0650	0.1375
0.5500	0.0683	0.1440
0.6000	0.0710	0.1494
0.6500	0.0730	0.1535
0.7000	0.0745	0.1564
0.7500	0.0753	0.1581
0.8000	0.0755	0.1586
0.8500	0.0751	0.1579
0.9000	0.0741	0.1560
0.9500	0.0724	0.1528
1.0000	0.0701	0.1485
1.0500	0.0672	0.1429
1.1000	0.0637	0.1361
1.1500	0.0595	0.1280
1.2000	0.0547	0.1186
1.2500	0.0493	0.1080
1.3000	0.0432	0.0960
1.3500	0.0364	0.0828
1.4000	0.0290	0.0681
1.4500	0.0210	0.0521
1.5000	0.0123	0.0347
1.5500	0.0029	0.0158
1.5698	0.0047	0.0047

RAD = 8.5000 INCHES

R_1 = 0.0048 INCHES

R_2 = 0.0048 INCHES

$L_{(SP)}$ = 0.8014 INCHES

$H_{(SP)}$ = 0.0934 INCHES

GAMMA = 19 DEG 40 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0048	0.0048
0.0500	0.0080	0.0271
0.1000	0.0164	0.0448
0.1500	0.0241	0.0612
0.2000	0.0313	0.0763
0.2500	0.0380	0.0902
0.3000	0.0440	0.1029
0.3500	0.0495	0.1144
0.4000	0.0544	0.1246
0.4500	0.0587	0.1337
0.5000	0.0624	0.1417
0.5500	0.0656	0.1485
0.6000	0.0682	0.1541
0.6500	0.0702	0.1585
0.7000	0.0716	0.1617
0.7500	0.0725	0.1636
0.8000	0.0728	0.1643
0.8500	0.0725	0.1638
0.9000	0.0716	0.1621
0.9500	0.0701	0.1592
1.0000	0.0681	0.1551
1.0500	0.0654	0.1497
1.1000	0.0622	0.1431
1.1500	0.0584	0.1352
1.2000	0.0541	0.1261
1.2500	0.0491	0.1156
1.3000	0.0435	0.1039
1.3500	0.0373	0.0908
1.4000	0.0306	0.0764
1.4500	0.0232	0.0605
1.5000	0.0153	0.0434
1.5500	0.0067	0.0248
1.5919	0.0048	0.0048

STATOR 35 - Continued

RAD = 8.7500 INCHES	RAD = 9.0000 INCHES
R_1 = 0.0048 INCHES	R_1 = 0.0049 INCHES
R_2 = 0.0048 INCHES	R_2 = 0.0049 INCHES
$L_{(SP)}$ = 0.8122 INCHES	$L_{(SP)}$ = 0.8221 INCHES
$H_{(SP)}$ = 0.0942 INCHES	$H_{(SP)}$ = 0.0962 INCHES
GAMMA = 19 DEG 15 MIN	GAMMA = 19 DEG 0 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0048	0.0048	0.0000	0.0049	0.0049
0.0500	0.0075	0.0276	0.0500	0.0072	0.0284
0.1000	0.0154	0.0458	0.1000	0.0148	0.0472
0.1500	0.0228	0.0626	0.1500	0.0218	0.0647
0.2000	0.0296	0.0781	0.2000	0.0284	0.0808
0.2500	0.0359	0.0924	0.2500	0.0344	0.0955
0.3000	0.0416	0.1054	0.3000	0.0399	0.1090
0.3500	0.0468	0.1171	0.3500	0.0449	0.1212
0.4000	0.0514	0.1277	0.4000	0.0494	0.1322
0.4500	0.0555	0.1371	0.4500	0.0533	0.1419
0.5000	0.0591	0.1453	0.5000	0.0568	0.1505
0.5500	0.0621	0.1524	0.5500	0.0598	0.1578
0.6000	0.0646	0.1582	0.6000	0.0622	0.1639
0.6500	0.0665	0.1628	0.6500	0.0642	0.1688
0.7000	0.0679	0.1662	0.7000	0.0656	0.1724
0.7500	0.0688	0.1684	0.7500	0.0665	0.1748
0.8000	0.0691	0.1693	0.8000	0.0669	0.1760
0.8500	0.0689	0.1691	0.8500	0.0669	0.1760
0.9000	0.0682	0.1676	0.9000	0.0663	0.1747
0.9500	0.0669	0.1649	0.9500	0.0652	0.1722
1.0000	0.0651	0.1610	1.0000	0.0636	0.1685
1.0500	0.0628	0.1559	1.0500	0.0615	0.1636
1.1000	0.0599	0.1495	1.1000	0.0589	0.1574
1.1500	0.0565	0.1419	1.1500	0.0558	0.1500
1.2000	0.0526	0.1330	1.2000	0.0522	0.1413
1.2500	0.0481	0.1229	1.2500	0.0481	0.1313
1.3000	0.0431	0.1114	1.3000	0.0434	0.1200
1.3500	0.0375	0.0986	1.3500	0.0383	0.1074
1.4000	0.0314	0.0845	1.4000	0.0327	0.0934
1.4500	0.0248	0.0690	1.4500	0.0265	0.0781
1.5000	0.0176	0.0521	1.5000	0.0199	0.0613
1.5500	0.0098	0.0337	1.5500	0.0127	0.0431
1.6000	0.0015	0.0139	1.6000	0.0050	0.0234
1.6140	0.0048	0.0048	1.6363	0.0049	0.0049

STATOR 35 - Concluded

RAD = 9.4000 INCHES	RAD = 9.5520 INCHES
R_1 = 0.0050 INCHES	R_1 = 0.0050 INCHES
R_2 = 0.0050 INCHES	R_2 = 0.0051 INCHES
$L_{(SP)}$ = 0.8375 INCHES	$L_{(SP)}$ = 0.8433 INCHES
$H_{(SP)}$ = 0.0976 INCHES	$H_{(SP)}$ = 0.0983 INCHES
GAMMA = 18 DEG 33 MIN	GAMMA = 18 DEG 27 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0050	0.0050	0.0000	0.0050	0.0050
0.0500	0.0064	0.0295	0.0500	0.0062	0.0299
0.1000	0.0132	0.0492	0.1000	0.0127	0.0500
0.1500	0.0196	0.0674	0.1500	0.0188	0.0687
0.2000	0.0255	0.0843	0.2000	0.0245	0.0855
0.2500	0.0309	0.0997	0.2500	0.0297	0.1015
0.3000	0.0359	0.1138	0.3000	0.0345	0.1159
0.3500	0.0404	0.1266	0.3500	0.0388	0.1289
0.4000	0.0445	0.1381	0.4000	0.0428	0.1405
0.4500	0.0481	0.1482	0.4500	0.0463	0.1509
0.5000	0.0513	0.1571	0.5000	0.0493	0.1600
0.5500	0.0540	0.1648	0.5500	0.0520	0.1677
0.6000	0.0563	0.1712	0.6000	0.0542	0.1742
0.6500	0.0582	0.1764	0.6500	0.0560	0.1795
0.7000	0.0596	0.1804	0.7000	0.0574	0.1836
0.7500	0.0605	0.1831	0.7500	0.0583	0.1864
0.8000	0.0610	0.1846	0.8000	0.0589	0.1881
0.8500	0.0611	0.1849	0.8500	0.0590	0.1885
0.9000	0.0607	0.1840	0.9000	0.0587	0.1877
0.9500	0.0598	0.1818	0.9500	0.0579	0.1857
1.0000	0.0566	0.1785	1.0000	0.0568	0.1824
1.0500	0.0569	0.1739	1.0500	0.0552	0.1780
1.1000	0.0547	0.1681	1.1000	0.0532	0.1723
1.1500	0.0521	0.1610	1.1500	0.0508	0.1654
1.2000	0.0491	0.1527	1.2000	0.0480	0.1572
1.2500	0.0456	0.1431	1.2500	0.0448	0.1478
1.3000	0.0418	0.1322	1.3000	0.0412	0.1371
1.3500	0.0374	0.1200	1.3500	0.0371	0.1251
1.4000	0.0327	0.1065	1.4000	0.0327	0.1117
1.4500	0.0275	0.0916	1.4500	0.0278	0.0970
1.5000	0.0218	0.0754	1.5000	0.0225	0.0809
1.5500	0.0158	0.0577	1.5500	0.0168	0.0634
1.6000	0.0093	0.0385	1.6000	0.0107	0.0444
1.6500	0.0024	0.0179	1.6500	0.0042	0.0239
1.6719	0.0050	0.0050	1.6857	0.0051	0.0051

BLADE MANUFACTURING COORDINATES FOR ROTOR 36

RAD = 7.0000 INCHES

R_1 = 0.0075 INCHES

R_2 = 0.0085 INCHES

$L_{(SP)}$ = 0.8421 INCHES

$H_{(SP)}$ = 0.1099 INCHES

GAMMA = 40 DEG 48 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0075	0.0075
0.0500	0.0034	0.0304
0.1000	0.0074	0.0472
0.1500	0.0114	0.0633
0.2000	0.0155	0.0786
0.2500	0.0195	0.0933
0.3000	0.0237	0.1071
0.3500	0.0278	0.1203
0.4000	0.0320	0.1327
0.4500	0.0363	0.1445
0.5000	0.0406	0.1556
0.5500	0.0450	0.1661
0.6000	0.0495	0.1757
0.6500	0.0540	0.1843
0.7000	0.0584	0.1921
0.7500	0.0625	0.1986
0.8000	0.0661	0.2037
0.8500	0.0691	0.2074
0.9000	0.0715	0.2096
0.9500	0.0732	0.2103
1.0000	0.0742	0.2094
1.0500	0.0745	0.2069
1.1000	0.0739	0.2027
1.1500	0.0725	0.1967
1.2000	0.0702	0.1889
1.2500	0.0669	0.1791
1.3000	0.0625	0.1672
1.3500	0.0570	0.1530
1.4000	0.0502	0.1364
1.4500	0.0420	0.1170
1.5000	0.0324	0.0945
1.5500	0.0210	0.0683
1.6000	0.0078	0.0378
1.6362	0.0085	0.0085

RAD = 7.1450 INCHES

R_1 = 0.0073 INCHES

R_2 = 0.0081 INCHES

$L_{(SP)}$ = 0.8437 INCHES

$H_{(SP)}$ = 0.0963 INCHES

GAMMA = 41 DEG 53 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0073	0.0073
0.0500	0.0028	0.0289
0.1000	0.0061	0.0444
0.1500	0.0095	0.0592
0.2000	0.0128	0.0733
0.2500	0.0162	0.0867
0.3000	0.0196	0.0994
0.3500	0.0230	0.1114
0.4000	0.0264	0.1228
0.4500	0.0299	0.1334
0.5000	0.0333	0.1433
0.5500	0.0366	0.1524
0.6000	0.0401	0.1609
0.6500	0.0437	0.1689
0.7000	0.0479	0.1762
0.7500	0.0514	0.1821
0.8000	0.0535	0.1865
0.8500	0.0553	0.1894
0.9000	0.0570	0.1911
0.9500	0.0583	0.1914
1.0000	0.0591	0.1903
1.0500	0.0591	0.1876
1.1000	0.0585	0.1833
1.1500	0.0571	0.1775
1.2000	0.0551	0.1700
1.2500	0.0523	0.1608
1.3000	0.0487	0.1498
1.3500	0.0443	0.1368
1.4000	0.0390	0.1218
1.4500	0.0327	0.1045
1.5000	0.0253	0.0848
1.5500	0.0168	0.0622
1.6000	0.0070	0.0365
1.6413	0.0081	0.0081

RAD = 7.3050 INCHES

R_1 = 0.0071 INCHES

R_2 = 0.0078 INCHES

$L_{(SP)}$ = 0.8449 INCHES

$H_{(SP)}$ = 0.0828 INCHES

GAMMA = 43 DEG 12 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0071	0.0071
0.0500	0.0021	0.0272
0.1000	0.0047	0.0413
0.1500	0.0072	0.0548
0.2000	0.0098	0.0676
0.2500	0.0123	0.0798
0.3000	0.0149	0.0912
0.3500	0.0175	0.1020
0.4000	0.0201	0.1122
0.4500	0.0227	0.1217
0.5000	0.0254	0.1306
0.5500	0.0281	0.1389
0.6000	0.0308	0.1464
0.6500	0.0333	0.1532
0.7000	0.0355	0.1591
0.7500	0.0379	0.1643
0.8000	0.0404	0.1686
0.8500	0.0424	0.1715
0.9000	0.0437	0.1729
0.9500	0.0444	0.1729
1.0000	0.0447	0.1715
1.0500	0.0445	0.1688
1.1000	0.0440	0.1647
1.1500	0.0429	0.1592
1.2000	0.0413	0.1523
1.2500	0.0391	0.1438
1.3000	0.0363	0.1337
1.3500	0.0329	0.1219
1.4000	0.0289	0.1085
1.4500	0.0242	0.0931
1.5000	0.0188	0.0759
1.5500	0.0127	0.0565
1.6000	0.0057	0.0347
1.6458	0.0078	0.0078

ROTOR 36 - Continued

RAD = 7.3500 INCHES

R_1 = 0.0071 INCHES
R_2 = 0.0077 INCHES

$L_{(SP)}$ = 0.0451 INCHES
$H_{(SP)}$ = 0.0792 INCHES
GAMMA = 43 DEG 35 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0071	0.0071
0.0500	0.0020	0.0268
0.1000	0.0042	0.0405
0.1500	0.0066	0.0536
0.2000	0.0089	0.0661
0.2500	0.0113	0.0779
0.3000	0.0136	0.0890
0.3500	0.0160	0.0995
0.4000	0.0184	0.1094
0.4500	0.0208	0.1186
0.5000	0.0232	0.1272
0.5500	0.0257	0.1352
0.6000	0.0282	0.1425
0.6500	0.0305	0.1490
0.7000	0.0326	0.1547
0.7500	0.0347	0.1598
0.8000	0.0370	0.1639
0.8500	0.0389	0.1667
0.9000	0.0401	0.1681
0.9500	0.0408	0.1680
1.0000	0.0411	0.1666
1.0500	0.0409	0.1640
1.1000	0.0404	0.1600
1.1500	0.0394	0.1546
1.2000	0.0379	0.1478
1.2500	0.0358	0.1395
1.3000	0.0333	0.1297
1.3500	0.0301	0.1182
1.4000	0.0265	0.1052
1.4500	0.0222	0.0904
1.5000	0.0173	0.0737
1.5500	0.0117	0.0550
1.6000	0.0054	0.0342
1.6468	0.0077	0.0077

RAD = 7.5000 INCHES

R_1 = 0.0069 INCHES
R_2 = 0.0074 INCHES

$L_{(SP)}$ = 0.0460 INCHES
$H_{(SP)}$ = 0.0683 INCHES
GAMMA = 44 DEG 55 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0069	0.0069
0.0500	0.0013	0.0253
0.1000	0.0029	0.0379
0.1500	0.0045	0.0498
0.2000	0.0061	0.0611
0.2500	0.0078	0.0718
0.3000	0.0095	0.0820
0.3500	0.0112	0.0915
0.4000	0.0129	0.1004
0.4500	0.0146	0.1087
0.5000	0.0164	0.1164
0.5500	0.0182	0.1235
0.6000	0.0200	0.1299
0.6500	0.0218	0.1358
0.7000	0.0236	0.1412
0.7500	0.0254	0.1458
0.8000	0.0271	0.1494
0.8500	0.0284	0.1518
0.9000	0.0294	0.1531
0.9500	0.0300	0.1531
1.0000	0.0303	0.1518
1.0500	0.0302	0.1493
1.1000	0.0298	0.1456
1.1500	0.0291	0.1406
1.2000	0.0279	0.1343
1.2500	0.0264	0.1267
1.3000	0.0245	0.1177
1.3500	0.0221	0.1073
1.4000	0.0194	0.0955
1.4500	0.0163	0.0822
1.5000	0.0127	0.0673
1.5500	0.0087	0.0507
1.6000	0.0042	0.0324
1.6499	0.0074	0.0074

RAD = 7.7500 INCHES

R_1 = 0.0066 INCHES
R_2 = 0.0070 INCHES

$L_{(SP)}$ = 0.0477 INCHES
$H_{(SP)}$ = 0.0533 INCHES
GAMMA = 47 DEG 9 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0066	0.0066
0.0500	0.0004	0.0231
0.1000	0.0010	0.0338
0.1500	0.0016	0.0440
0.2000	0.0023	0.0536
0.2500	0.0029	0.0627
0.3000	0.0037	0.0713
0.3500	0.0045	0.0794
0.4000	0.0053	0.0870
0.4500	0.0062	0.0940
0.5000	0.0071	0.1006
0.5500	0.0080	0.1065
0.6000	0.0090	0.1120
0.6500	0.0102	0.1170
0.7000	0.0116	0.1216
0.7500	0.0129	0.1256
0.8000	0.0137	0.1287
0.8500	0.0148	0.1309
0.9000	0.0156	0.1321
0.9500	0.0162	0.1323
1.0000	0.0165	0.1313
1.0500	0.0166	0.1293
1.1000	0.0165	0.1261
1.1500	0.0162	0.1218
1.2000	0.0156	0.1163
1.2500	0.0148	0.1097
1.3000	0.0137	0.1020
1.3500	0.0124	0.0930
1.4000	0.0109	0.0829
1.4500	0.0091	0.0716
1.5000	0.0072	0.0589
1.5500	0.0049	0.0451
1.6000	0.0025	0.0298
1.6500	0.0008	0.0132
1.6537	0.0070	0.0070

ROTOR 36 - Continued

RAD = 0.0000 INCHES

R_1 = 0.0063 INCHES

R_2 = 0.0066 INCHES

$L_{(SP)}$ = 0.8509 INCHES

$H_{(SP)}$ = 0.0423 INCHES

GAMMA = 49 DEG 17 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0063	0.0063
0.0500	-0.0000	0.0211
0.1000	0.0000	0.0302
0.1500	0.0001	0.0389
0.2000	0.0002	0.0472
0.2500	0.0004	0.0551
0.3000	0.0006	0.0625
0.3500	0.0008	0.0695
0.4000	0.0011	0.0761
0.4500	0.0015	0.0822
0.5000	0.0019	0.0879
0.5500	0.0024	0.0933
0.6000	0.0029	0.0982
0.6500	0.0035	0.1026
0.7000	0.0043	0.1065
0.7500	0.0050	0.1100
0.8000	0.0055	0.1131
0.8500	0.0066	0.1155
0.9000	0.0073	0.1167
0.9500	0.0076	0.1168
1.0000	0.0077	0.1159
1.0500	0.0078	0.1140
1.1000	0.0078	0.1112
1.1500	0.0078	0.1074
1.2000	0.0075	0.1027
1.2500	0.0072	0.0968
1.3000	0.0067	0.0900
1.3500	0.0060	0.0822
1.4000	0.0053	0.0733
1.4500	0.0044	0.0634
1.5000	0.0035	0.0525
1.5500	0.0024	0.0405
1.6000	0.0012	0.0274
1.6500	0.0001	0.0132
1.6557	0.0066	0.0066

RAD = 0.2500 INCHES

R_1 = 0.0061 INCHES

R_2 = 0.0062 INCHES

$L_{(SP)}$ = 0.8578 INCHES

$H_{(SP)}$ = 0.0344 INCHES

GAMMA = 51 DEG 13 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0061	0.0061
0.0500	-0.0001	0.0195
0.1000	-0.0001	0.0274
0.1500	-0.0002	0.0349
0.2000	-0.0002	0.0421
0.2500	-0.0002	0.0490
0.3000	-0.0002	0.0555
0.3500	-0.0002	0.0616
0.4000	-0.0001	0.0674
0.4500	-0.0000	0.0728
0.5000	0.0001	0.0779
0.5500	0.0002	0.0826
0.6000	0.0004	0.0869
0.6500	0.0007	0.0910
0.7000	0.0010	0.0949
0.7500	0.0014	0.0984
0.8000	0.0018	0.1011
0.8500	0.0020	0.1032
0.9000	0.0023	0.1045
0.9500	0.0025	0.1049
1.0000	0.0027	0.1044
1.0500	0.0028	0.1030
1.1000	0.0028	0.1006
1.1500	0.0028	0.0973
1.2000	0.0027	0.0930
1.2500	0.0025	0.0878
1.3000	0.0023	0.0817
1.3500	0.0021	0.0747
1.4000	0.0018	0.0667
1.4500	0.0015	0.0578
1.5000	0.0012	0.0479
1.5500	0.0008	0.0371
1.6000	0.0004	0.0253
1.6500	0.0000	0.0125
1.6558	0.0062	0.0062

RAD = 0.5000 INCHES

R_1 = 0.0058 INCHES

R_2 = 0.0058 INCHES

$L_{(SP)}$ = 0.8586 INCHES

$H_{(SP)}$ = 0.0257 INCHES

GAMMA = 53 DEG 5 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0058	0.0058
0.0500	-0.0006	0.0177
0.1000	-0.0013	0.0243
0.1500	-0.0019	0.0307
0.2000	-0.0025	0.0367
0.2500	-0.0029	0.0425
0.3000	-0.0034	0.0480
0.3500	-0.0037	0.0532
0.4000	-0.0040	0.0582
0.4500	-0.0043	0.0628
0.5000	-0.0044	0.0672
0.5500	-0.0045	0.0713
0.6000	-0.0045	0.0751
0.6500	-0.0045	0.0786
0.7000	-0.0044	0.0821
0.7500	-0.0042	0.0853
0.8000	-0.0039	0.0879
0.8500	-0.0035	0.0901
0.9000	-0.0032	0.0917
0.9500	-0.0029	0.0925
1.0000	-0.0026	0.0924
1.0500	-0.0023	0.0914
1.1000	-0.0021	0.0896
1.1500	-0.0019	0.0868
1.2000	-0.0017	0.0832
1.2500	-0.0015	0.0787
1.3000	-0.0014	0.0734
1.3500	-0.0012	0.0672
1.4000	-0.0010	0.0601
1.4500	-0.0009	0.0522
1.5000	-0.0007	0.0434
1.5500	-0.0005	0.0337
1.6000	-0.0003	0.0232
1.6500	0.0000	0.0117
1.6554	0.0058	0.0058

ROTOR 36 - Continued

RAD = 8.7500 INCHES

R_1 = 0.0055 INCHES
R_2 = 0.0054 INCHES

$L_{(SP)}$ = 0.8644 INCHES
$H_{(SP)}$ = 0.0177 INCHES
GAMMA = 54 DEG 59 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0055	0.0055
0.0500	-0.0010	0.0160
0.1000	-0.0020	0.0214
0.1500	-0.0030	0.0265
0.2000	-0.0039	0.0315
0.2500	-0.0048	0.0362
0.3000	-0.0055	0.0407
0.3500	-0.0062	0.0450
0.4000	-0.0068	0.0491
0.4500	-0.0074	0.0530
0.5000	-0.0078	0.0567
0.5500	-0.0082	0.0602
0.6000	-0.0085	0.0635
0.6500	-0.0087	0.0665
0.7000	-0.0087	0.0694
0.7500	-0.0087	0.0721
0.8000	-0.0086	0.0746
0.8500	-0.0084	0.0770
0.9000	-0.0082	0.0790
0.9500	-0.0079	0.0802
1.0000	-0.0075	0.0806
1.0500	-0.0072	0.0801
1.1000	-0.0068	0.0788
1.1500	-0.0065	0.0767
1.2000	-0.0061	0.0738
1.2500	-0.0056	0.0703
1.3000	-0.0051	0.0654
1.3500	-0.0046	0.0600
1.4000	-0.0040	0.0538
1.4500	-0.0033	0.0468
1.5000	-0.0026	0.0390
1.5500	-0.0018	0.0303
1.6000	-0.0009	0.0209
1.6500	0.0003	0.0105
1.6535	0.0054	0.0054

RAD = 9.0000 INCHES

R_1 = 0.0052 INCHES
R_2 = 0.0051 INCHES

$L_{(SP)}$ = 0.8621 INCHES
$H_{(SP)}$ = 0.0107 INCHES
GAMMA = 56 DEG 46 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0052	0.0052
0.0500	-0.0015	0.0145
0.1000	-0.0031	0.0189
0.1500	-0.0045	0.0231
0.2000	-0.0059	0.0272
0.2500	-0.0072	0.0311
0.3000	-0.0083	0.0349
0.3500	-0.0093	0.0384
0.4000	-0.0102	0.0419
0.4500	-0.0110	0.0451
0.5000	-0.0117	0.0482
0.5500	-0.0122	0.0512
0.6000	-0.0126	0.0540
0.6500	-0.0128	0.0566
0.7000	-0.0130	0.0592
0.7500	-0.0129	0.0615
0.8000	-0.0128	0.0638
0.8500	-0.0124	0.0659
0.9000	-0.0119	0.0679
0.9500	-0.0113	0.0694
1.0000	-0.0106	0.0703
1.0500	-0.0100	0.0704
1.1000	-0.0093	0.0696
1.1500	-0.0086	0.0680
1.2000	-0.0079	0.0657
1.2500	-0.0071	0.0626
1.3000	-0.0064	0.0588
1.3500	-0.0056	0.0542
1.4000	-0.0047	0.0489
1.4500	-0.0039	0.0428
1.5000	-0.0030	0.0359
1.5500	-0.0021	0.0283
1.6000	-0.0011	0.0200
1.6500	-0.0001	0.0110
1.6592	0.0051	0.0051

RAD = 9.2500 INCHES

R_1 = 0.0049 INCHES
R_2 = 0.0047 INCHES

$L_{(SP)}$ = 0.8548 INCHES
$H_{(SP)}$ = 0.0030 INCHES
GAMMA = 58 DEG 41 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0049	0.0049
0.0500	-0.0021	0.0131
0.1000	-0.0044	0.0166
0.1500	-0.0064	0.0200
0.2000	-0.0084	0.0233
0.2500	-0.0101	0.0264
0.3000	-0.0117	0.0294
0.3500	-0.0132	0.0322
0.4000	-0.0144	0.0349
0.4500	-0.0155	0.0375
0.5000	-0.0165	0.0399
0.5500	-0.0172	0.0423
0.6000	-0.0178	0.0445
0.6500	-0.0182	0.0466
0.7000	-0.0183	0.0486
0.7500	-0.0183	0.0505
0.8000	-0.0181	0.0523
0.8500	-0.0178	0.0540
0.9000	-0.0172	0.0556
0.9500	-0.0164	0.0570
1.0000	-0.0154	0.0582
1.0500	-0.0144	0.0588
1.1000	-0.0134	0.0585
1.1500	-0.0124	0.0575
1.2000	-0.0114	0.0558
1.2500	-0.0103	0.0534
1.3000	-0.0092	0.0504
1.3500	-0.0080	0.0466
1.4000	-0.0068	0.0422
1.4500	-0.0056	0.0370
1.5000	-0.0042	0.0312
1.5500	-0.0029	0.0247
1.6000	-0.0015	0.0175
1.6500	-0.0000	0.0096
1.6561	0.0047	0.0047

ROTOR 36 - Continued

RAD = 9.5000 INCHES

R_1 = 0.0046 INCHES
R_2 = 0.0043 INCHES

$L_{(SP)}$ = 0.8529 INCHES
$H_{(SP)}$ = -0.0033 INCHES
GAMMA = 60 DEG 46 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0046	0.0046
0.0500	-0.0025	0.0118
0.1000	-0.0051	0.0145
0.1500	-0.0075	0.0171
0.2000	-0.0098	0.0195
0.2500	-0.0118	0.0219
0.3000	-0.0137	0.0241
0.3500	-0.0154	0.0263
0.4000	-0.0169	0.0284
0.4500	-0.0182	0.0303
0.5000	-0.0194	0.0322
0.5500	-0.0203	0.0340
0.6000	-0.0210	0.0357
0.6500	-0.0215	0.0373
0.7000	-0.0218	0.0389
0.7500	-0.0219	0.0404
0.8000	-0.0217	0.0419
0.8500	-0.0214	0.0432
0.9000	-0.0208	0.0446
0.9500	-0.0200	0.0459
1.0000	-0.0189	0.0472
1.0500	-0.0175	0.0486
1.1000	-0.0161	0.0493
1.1500	-0.0147	0.0493
1.2000	-0.0134	0.0485
1.2500	-0.0119	0.0470
1.3000	-0.0105	0.0449
1.3500	-0.0091	0.0419
1.4300	-0.0076	0.0382
1.4500	-0.0061	0.0337
1.5000	-0.0046	0.0285
1.5500	-0.0031	0.0225
1.6000	-0.0015	0.0157
1.6500	0.0015	0.0070
1.6510	0.0043	0.0043

RAD = 9.6500 INCHES

R_1 = 0.0044 INCHES
R_2 = 0.0040 INCHES

$L_{(SP)}$ = 0.8547 INCHES
$H_{(SP)}$ = -0.0073 INCHES
GAMMA = 62 DEG 9 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0044	0.0044
0.0500	-0.0027	0.0109
0.1000	-0.0055	0.0130
0.1500	-0.0081	0.0150
0.2000	-0.0105	0.0169
0.2500	-0.0127	0.0188
0.3000	-0.0148	0.0205
0.3500	-0.0166	0.0222
0.4000	-0.0183	0.0238
0.4500	-0.0197	0.0254
0.5000	-0.0210	0.0269
0.5500	-0.0220	0.0283
0.6000	-0.0228	0.0297
0.6500	-0.0234	0.0311
0.7000	-0.0239	0.0324
0.7500	-0.0241	0.0336
0.8000	-0.0240	0.0349
0.8500	-0.0236	0.0362
0.9000	-0.0228	0.0374
0.9500	-0.0221	0.0387
1.0000	-0.0215	0.0399
1.0500	-0.0209	0.0410
1.1000	-0.0188	0.0423
1.1500	-0.0171	0.0433
1.2000	-0.0157	0.0434
1.2500	-0.0141	0.0425
1.3000	-0.0125	0.0407
1.3500	-0.0108	0.0381
1.4000	-0.0092	0.0349
1.4500	-0.0075	0.0309
1.5000	-0.0057	0.0261
1.5500	-0.0038	0.0205
1.6000	-0.0018	0.0141
1.6469	0.0040	0.0040

RAD = 9.7490 INCHES

R_1 = 0.0043 INCHES
R_2 = 0.0038 INCHES

$L_{(SP)}$ = 0.8572 INCHES
$H_{(SP)}$ = -0.0107 INCHES
GAMMA = 63 DEG 8 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0043	0.0043
0.0500	-0.0028	0.0102
0.1000	-0.0057	0.0118
0.1500	-0.0085	0.0134
0.2000	-0.0110	0.0149
0.2500	-0.0134	0.0163
0.3000	-0.0155	0.0177
0.3500	-0.0175	0.0190
0.4000	-0.0193	0.0203
0.4500	-0.0208	0.0215
0.5000	-0.0222	0.0227
0.5500	-0.0233	0.0239
0.6000	-0.0243	0.0250
0.6500	-0.0250	0.0261
0.7000	-0.0255	0.0272
0.7500	-0.0258	0.0284
0.8000	-0.0259	0.0295
0.8500	-0.0257	0.0306
0.9000	-0.0252	0.0318
0.9500	-0.0246	0.0330
1.0000	-0.0238	0.0343
1.0500	-0.0227	0.0355
1.1000	-0.0213	0.0369
1.1500	-0.0197	0.0382
1.2000	-0.0181	0.0386
1.2500	-0.0165	0.0381
1.3000	-0.0149	0.0367
1.3500	-0.0132	0.0345
1.4000	-0.0113	0.0316
1.4500	-0.0093	0.0280
1.5000	-0.0072	0.0237
1.5500	-0.0048	0.0186
1.6000	-0.0023	0.0128
1.6439	0.0038	0.0038

ROTOR 36 - Continued

RAD = 9.8000 INCHES

R_1 = 0.0042 INCHES

R_2 = 0.0037 INCHES

$L_{(SP)}$ = 0.8509 INCHES

$H_{(SP)}$ = -0.0127 INCHES

GAMMA = 63 DEG 40 MIN

RAD = 9.8500 INCHES

R_1 = 0.0042 INCHES

R_2 = 0.0037 INCHES

$L_{(SP)}$ = 0.8609 INCHES

$H_{(SP)}$ = -0.0150 INCHES

GAMMA = 64 DEG 12 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0042	0.0042	0.0000	0.0042	0.0042
0.0500	-0.0029	0.0098	0.0500	-0.0030	0.0094
0.1000	-0.0059	0.0111	0.1000	-0.0060	0.0104
0.1500	-0.0087	0.0124	0.1500	-0.0089	0.0115
0.2000	-0.0113	0.0137	0.2000	-0.0116	0.0124
0.2500	-0.0137	0.0149	0.2500	-0.0141	0.0134
0.3000	-0.0160	0.0160	0.3000	-0.0165	0.0143
0.3500	-0.0180	0.0171	0.3500	-0.0186	0.0151
0.4000	-0.0199	0.0182	0.4000	-0.0205	0.0160
0.4500	-0.0215	0.0193	0.4500	-0.0222	0.0169
0.5000	-0.0229	0.0203	0.5000	-0.0238	0.0177
0.5500	-0.0242	0.0213	0.5500	-0.0251	0.0185
0.6000	-0.0252	0.0223	0.6000	-0.0262	0.0193
0.6500	-0.0260	0.0233	0.6500	-0.0271	0.0202
0.7000	-0.0265	0.0242	0.7000	-0.0276	0.0212
0.7500	-0.0269	0.0252	0.7500	-0.0280	0.0222
0.8000	-0.0270	0.0263	0.8000	-0.0283	0.0231
0.8500	-0.0270	0.0275	0.8500	-0.0285	0.0239
0.9000	-0.0268	0.0288	0.9000	-0.0286	0.0246
0.9500	-0.0262	0.0300	0.9500	-0.0281	0.0257
1.0000	-0.0252	0.0315	1.0000	-0.0267	0.0275
1.0500	-0.0237	0.0356	1.0500	-0.0245	0.0291
1.1000	-0.0223	0.0352	1.1000	-0.0230	0.0315
1.1500	-0.0215	0.0352	1.1500	-0.0236	0.0317
1.2000	-0.0203	0.0349	1.2000	-0.0232	0.0316
1.2500	-0.0186	0.0346	1.2500	-0.0214	0.0315
1.3000	-0.0167	0.0339	1.3000	-0.0189	0.0310
1.3500	-0.0148	0.0323	1.3500	-0.0166	0.0296
1.4000	-0.0128	0.0296	1.4000	-0.0145	0.0272
1.4500	-0.0107	0.0262	1.4500	-0.0122	0.0240
1.5000	-0.0083	0.0221	1.5000	-0.0095	0.0203
1.5500	-0.0056	0.0174	1.5500	-0.0064	0.0160
1.6000	-0.0025	0.0120	1.6000	-0.0029	0.0112
1.6422	0.0037	0.0037	1.6405	0.0037	0.0037

ROTOR 36 - Concluded

RAD = 9.9000 INCHES		RAD = 9.9560 INCHES	
R_1 = 0.0041 INCHES		R_1 = 0.0040 INCHES	
R_2 = 0.0036 INCHES		R_2 = 0.0035 INCHES	
$L_{(SP)}$ = 0.8632 INCHES		$L_{(SP)}$ = 0.8661 INCHES	
$H_{(SP)}$ = -0.0175 INCHES		$H_{(SP)}$ = -0.0206 INCHES	
GAMMA = 64 DEG 45 MIN		GAMMA = 65 DEG 24 MIN	

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0041	0.0041	0.0000	0.0040	0.0040
0.0500	-0.0031	0.0089	0.0500	-0.0032	0.0084
0.1000	-0.0062	0.0097	0.1000	-0.0064	0.0087
0.1500	-0.0092	0.0104	0.1500	-0.0095	0.0091
0.2000	-0.0120	0.0111	0.2000	-0.0124	0.0094
0.2500	-0.0146	0.0117	0.2500	-0.0151	0.0097
0.3000	-0.0170	0.0123	0.3000	-0.0177	0.0100
0.3500	-0.0192	0.0130	0.3500	-0.0200	0.0103
0.4000	-0.0212	0.0136	0.4000	-0.0221	0.0106
0.4500	-0.0231	0.0142	0.4500	-0.0241	0.0110
0.5000	-0.0247	0.0148	0.5000	-0.0258	0.0114
0.5500	-0.0261	0.0155	0.5500	-0.0274	0.0118
0.6000	-0.0273	0.0162	0.6000	-0.0287	0.0123
0.6500	-0.0283	0.0169	0.6500	-0.0298	0.0128
0.7000	-0.0290	0.0176	0.7000	-0.0307	0.0133
0.7500	-0.0296	0.0184	0.7500	-0.0314	0.0140
0.8000	-0.0299	0.0193	0.8000	-0.0319	0.0147
0.8500	-0.0300	0.0203	0.8500	-0.0321	0.0157
0.9000	-0.0298	0.0214	0.9000	-0.0321	0.0168
0.9500	-0.0295	0.0226	0.9500	-0.0318	0.0181
1.0000	-0.0289	0.0239	1.0000	-0.0315	0.0193
1.0500	-0.0282	0.0256	1.0500	-0.0310	0.0206
1.1000	-0.0273	0.0270	1.1000	-0.0303	0.0217
1.1500	-0.0261	0.0276	1.1500	-0.0294	0.0225
1.2000	-0.0247	0.0284	1.2000	-0.0282	0.0233
1.2500	-0.0231	0.0285	1.2500	-0.0265	0.0236
1.3000	-0.0212	0.0277	1.3000	-0.0245	0.0233
1.3500	-0.0191	0.0263	1.3500	-0.0222	0.0223
1.4000	-0.0167	0.0243	1.4000	-0.0196	0.0206
1.4500	-0.0141	0.0216	1.4500	-0.0165	0.0184
1.5000	-0.0110	0.0183	1.5000	-0.0129	0.0157
1.5500	-0.0074	0.0145	1.5500	-0.0086	0.0127
1.6000	-0.0032	0.0103	1.6000	-0.0037	0.0093
1.6388	0.0036	0.0036	1.6369	0.0035	0.0035

BLADE MANUFACTURING COORDINATES FOR STATOR 36

RAD = 7.3550 INCHES

R_1 = 0.0045 INCHES
R_2 = 0.0045 INCHES

$L_{(SP)}$ = 0.5625 INCHES
$H_{(SP)}$ = 0.0675 INCHES
GAMMA = 23 DEG 42 MIN

RAD = 7.4930 INCHES

R_1 = 0.0045 INCHES
R_2 = 0.0045 INCHES

$L_{(SP)}$ = 0.5667 INCHES
$H_{(SP)}$ = 0.0680 INCHES
GAMMA = 23 DEG 14 MIN

RAD = 7.7000 INCHES

R_1 = 0.0046 INCHES
R_2 = 0.0045 INCHES

$L_{(SP)}$ = 0.5729 INCHES
$H_{(SP)}$ = 0.0686 INCHES
GAMMA = 22 DEG 34 MIN

L	HP	HS	L	HP	HS	L	HP	HS
INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
0.0000	0.0045	0.0045	0.0000	0.0045	0.0045	0.0000	0.0046	0.0046
0.0500	0.0083	0.0252	0.0500	0.0083	0.0255	0.0500	0.0082	0.0260
0.1000	0.0168	0.0411	0.1000	0.0167	0.0417	0.1000	0.0166	0.0425
0.1500	0.0244	0.0555	0.1500	0.0244	0.0562	0.1500	0.0242	0.0573
0.2000	0.0314	0.0683	0.2000	0.0312	0.0692	0.2000	0.0309	0.0706
0.2500	0.0375	0.0796	0.2500	0.0373	0.0807	0.2500	0.0369	0.0822
0.3000	0.0429	0.0895	0.3000	0.0426	0.0906	0.3000	0.0421	0.0923
0.3500	0.0475	0.0979	0.3500	0.0471	0.0991	0.3500	0.0465	0.1009
0.4000	0.0514	0.1050	0.4000	0.0509	0.1061	0.4000	0.0501	0.1079
0.4500	0.0544	0.1103	0.4500	0.0538	0.1116	0.4500	0.0529	0.1134
0.5000	0.0564	0.1139	0.5000	0.0550	0.1152	0.5000	0.0548	0.1171
0.5500	0.0575	0.1157	0.5500	0.0568	0.1171	0.5500	0.0558	0.1191
0.6000	0.0575	0.1157	0.6000	0.0569	0.1172	0.6000	0.0559	0.1193
0.6500	0.0566	0.1140	0.6500	0.0560	0.1155	0.6500	0.0551	0.1178
0.7000	0.0547	0.1104	0.7000	0.0542	0.1121	0.7000	0.0534	0.1145
0.7500	0.0517	0.1050	0.7500	0.0514	0.1069	0.7500	0.0508	0.1095
0.8000	0.0478	0.0978	0.8000	0.0476	0.0998	0.8000	0.0472	0.1027
0.8500	0.0428	0.0887	0.8500	0.0429	0.0909	0.8500	0.0428	0.0940
0.9000	0.0368	0.0777	0.9000	0.0371	0.0801	0.9000	0.0374	0.0835
0.9500	0.0297	0.0647	0.9500	0.0303	0.0673	0.9500	0.0310	0.0712
1.0000	0.0215	0.0497	1.0000	0.0225	0.0526	1.0000	0.0237	0.0568
1.0500	0.0123	0.0325	1.0500	0.0136	0.0357	1.0500	0.0154	0.0404
1.1000	0.0019	0.0131	1.1000	0.0037	0.0167	1.1000	0.0061	0.0220
1.1135	0.0045	0.0045	1.1223	0.0045	0.0045	1.1354	0.0045	0.0045

STATOR 36 - Continued

```
RAD     =  8.0000  INCHES          RAD     =  8.2000  INCHES          RAD     =  8.4000  INCHES


R1      =  0.0046  INCHES          R1      =  0.0047  INCHES          R1      =  0.0047  INCHES
R2      =  0.0046  INCHES          R2      =  0.0047  INCHES          R2      =  0.0047  INCHES

L(SP)   =  0.5819  INCHES          L(SP)   =  0.5878  INCHES          L(SP)   =  0.5938  INCHES
H(SP)   =  0.0693  INCHES          H(SP)   =  0.0702  INCHES          H(SP)   =  0.0714  INCHES
GAMMA   =  21 DEG  43 MIN          GAMMA   =  21 DEG  18 MIN          GAMMA   =  20 DEG  59 MIN

  L        HP        HS          L        HP        HS          L        HP        HS
INCHES   INCHES    INCHES      INCHES   INCHES    INCHES      INCHES   INCHES    INCHES
0.0000   0.0046    0.0046      0.0000   0.0047    0.0047      0.0000   0.0047    0.0047
0.0500   0.0081    0.0265      0.0500   0.0080    0.0270      0.0500   0.0079    0.0274
0.1000   0.0162    0.0435      0.1000   0.0161    0.0443      0.1000   0.0160    0.0451
0.1500   0.0236    0.0567      0.1500   0.0234    0.0598      0.1500   0.0232    0.0610
0.2000   0.0302    0.0723      0.2000   0.0299    0.0736      0.2000   0.0297    0.0751
0.2500   0.0360    0.0842      0.2500   0.0356    0.0857      0.2500   0.0354    0.0875
0.3000   0.0411    0.0945      0.3000   0.0406    0.0962      0.3000   0.0403    0.0983
0.3500   0.0453    0.1032      0.3500   0.0447    0.1051      0.3500   0.0445    0.1074
0.4000   0.0487    0.1104      0.4000   0.0481    0.1124      0.4000   0.0478    0.1149
0.4500   0.0514    0.1160      0.4500   0.0507    0.1181      0.4500   0.0504    0.1207
0.5000   0.0532    0.1198      0.5000   0.0525    0.1221      0.5000   0.0523    0.1249
0.5500   0.0541    0.1219      0.5500   0.0535    0.1244      0.5500   0.0533    0.1273
0.6000   0.0543    0.1224      0.6000   0.0537    0.1249      0.6000   0.0535    0.1281
0.6500   0.0536    0.1211      0.6500   0.0531    0.1238      0.6500   0.0530    0.1271
0.7000   0.0521    0.1181      0.7000   0.0516    0.1209      0.7000   0.0517    0.1244
0.7500   0.0497    0.1133      0.7500   0.0494    0.1164      0.7500   0.0496    0.1201
0.8000   0.0465    0.1069      0.8000   0.0464    0.1101      0.8000   0.0468    0.1140
0.8500   0.0425    0.0986      0.8500   0.0426    0.1021      0.8500   0.0431    0.1061
0.9000   0.0375    0.0885      0.9000   0.0379    0.0923      0.9000   0.0386    0.0965
0.9500   0.0318    0.0766      0.9500   0.0324    0.0806      0.9500   0.0334    0.0850
1.0000   0.0251    0.0629      1.0000   0.0261    0.0671      1.0000   0.0274    0.0717
1.0500   0.0176    0.0471      1.0500   0.0190    0.0517      1.0500   0.0205    0.0565
1.1000   0.0092    0.0293      1.1000   0.0110    0.0342      1.1000   0.0128    0.0393
1.1500   0.0000    0.0095      1.1500   0.0022    0.0147      1.1500   0.0044    0.0201
1.1542   0.0046    0.0046      1.1667   0.0047    0.0047      1.1792   0.0047    0.0047
```

STATOR 36 - Continued

RAD	=	9.0000 INCHES	RAD	=	9.2000 INCHES
R_1	=	0.0039 INCHES	R_1	=	0.0049 INCHES
R_2	=	0.0049 INCHES	R_2	=	0.0049 INCHES
$L_{(SP)}$	=	0.6109 INCHES	$L_{(SP)}$	=	0.6163 INCHES
$H_{(SP)}$	=	0.0749 INCHES	$H_{(SP)}$	=	0.0767 INCHES
GAMMA	=	20 DEG 10 MIN	GAMMA	=	20 DEG 2 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0049	0.0049	0.0000	0.0049	0.0049
0.0500	0.0075	0.0288	0.0500	0.0075	0.0294
0.1000	0.0152	0.0476	0.1000	0.0152	0.0487
0.1500	0.0222	0.0644	0.1500	0.0222	0.0660
0.2000	0.0285	0.0794	0.2000	0.0285	0.0814
0.2500	0.0340	0.0926	0.2500	0.0340	0.0950
0.3000	0.0388	0.1041	0.3000	0.0388	0.1067
0.3500	0.0429	0.1138	0.3500	0.0429	0.1168
0.4000	0.0463	0.1219	0.4000	0.0464	0.1250
0.4500	0.0489	0.1283	0.4500	0.0491	0.1316
0.5000	0.0508	0.1329	0.5000	0.0511	0.1365
0.5500	0.0520	0.1359	0.5500	0.0523	0.1397
0.6000	0.0525	0.1372	0.6000	0.0529	0.1411
0.6500	0.0523	0.1368	0.6500	0.0528	0.1408
0.7000	0.0513	0.1347	0.7000	0.0519	0.1389
0.7500	0.0497	0.1309	0.7500	0.0503	0.1352
0.8000	0.0473	0.1253	0.8000	0.0481	0.1298
0.8500	0.0442	0.1181	0.8500	0.0451	0.1227
0.9000	0.0403	0.1090	0.9000	0.0414	0.1138
0.9500	0.0358	0.0982	0.9500	0.0369	0.1031
1.0000	0.0305	0.0855	1.0000	0.0318	0.0906
1.0500	0.0245	0.0710	1.0500	0.0260	0.0762
1.1000	0.0177	0.0545	1.1000	0.0194	0.0598
1.1500	0.0102	0.0360	1.1500	0.0121	0.0415
1.2000	0.0020	0.0154	1.2000	0.0041	0.0210
1.2167	0.0049	0.0049	1.2291	0.0049	0.0049

STATOR 36 - Concluded

RAD = 9.5030 INCHES

R_1 = 0.0050 INCHES
R_2 = 0.0050 INCHES

$L_{(SP)}$ = 0.6245 INCHES
$H_{(SP)}$ = 0.0789 INCHES
GAMMA = 19 DEG 52 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0050	0.0050
0.0500	0.0073	0.0303
0.1000	0.0149	0.0502
0.1500	0.0218	0.0682
0.2000	0.0280	0.0841
0.2500	0.0335	0.0982
0.3000	0.0383	0.1104
0.3500	0.0424	0.1208
0.4000	0.0459	0.1293
0.4500	0.0486	0.1362
0.5000	0.0507	0.1413
0.5500	0.0521	0.1447
0.6000	0.0528	0.1464
0.6500	0.0528	0.1464
0.7000	0.0521	0.1448
0.7500	0.0507	0.1414
0.8000	0.0487	0.1362
0.8500	0.0459	0.1294
0.9000	0.0425	0.1208
0.9500	0.0383	0.1104
1.0000	0.0335	0.0981
1.0500	0.0280	0.0840
1.1000	0.0217	0.0679
1.1500	0.0148	0.0499
1.2000	0.0071	0.0297
1.2481	0.0050	0.0050

RAD = 9.6110 INCHES

R_1 = 0.0050 INCHES
R_2 = 0.0051 INCHES

$L_{(SP)}$ = 0.6274 INCHES
$H_{(SP)}$ = 0.0804 INCHES
GAMMA = 19 DEG 55 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0050	0.0050
0.0500	0.0074	0.0307
0.1000	0.0151	0.0511
0.1500	0.0220	0.0694
0.2000	0.0283	0.0856
0.2500	0.0339	0.0999
0.3000	0.0387	0.1124
0.3500	0.0429	0.1229
0.4000	0.0464	0.1317
0.4500	0.0492	0.1386
0.5000	0.0514	0.1439
0.5500	0.0528	0.1474
0.6000	0.0536	0.1492
0.6500	0.0536	0.1493
0.7000	0.0530	0.1477
0.7500	0.0517	0.1444
0.8000	0.0497	0.1394
0.8500	0.0470	0.1326
0.9000	0.0436	0.1241
0.9500	0.0395	0.1137
1.0000	0.0347	0.1015
1.0500	0.0292	0.0874
1.1000	0.0230	0.0714
1.1500	0.0160	0.0533
1.2000	0.0083	0.0331
1.2500	0.0000	0.0106
1.2550	0.0051	0.0051

BLADE MANUFACTURING COORDINATES FOR ROTOR 37

RAD = 7.0000 INCHES

R_1 = 0.0099 INCHES
R_2 = 0.0118 INCHES

$L_{(SP)}$ = 1.1181 INCHES
$H_{(SP)}$ = 0.1967 INCHES
GAMMA = 36 DEG 32 MIN

RAD = 7.2000 INCHES

R_1 = 0.0096 INCHES
R_2 = 0.0110 INCHES

$L_{(SP)}$ = 1.1200 INCHES
$H_{(SP)}$ = 0.1685 INCHES
GAMMA = 36 DEG 30 MIN

RAD = 7.4800 INCHES

R_1 = 0.0091 INCHES
R_2 = 0.0101 INCHES

$L_{(SP)}$ = 1.1212 INCHES
$H_{(SP)}$ = 0.1355 INCHES
GAMMA = 41 DEG 25 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0099	0.0099	0.0000	0.0096	0.0096	0.0000	0.0091	0.0091
0.1000	0.0131	0.0586	0.1000	0.0115	0.0543	0.1000	0.0087	0.0483
0.2000	0.0276	0.0982	0.2000	0.0240	0.0901	0.2000	0.0181	0.0789
0.3000	0.0419	0.1353	0.3000	0.0364	0.1235	0.3000	0.0274	0.1073
0.4000	0.0562	0.1699	0.4000	0.0485	0.1546	0.4000	0.0365	0.1337
0.5000	0.0703	0.2021	0.5000	0.0605	0.1833	0.5000	0.0454	0.1580
0.6000	0.0845	0.2319	0.6000	0.0724	0.2098	0.6000	0.0542	0.1802
0.7000	0.0988	0.2600	0.7000	0.0840	0.2340	0.7000	0.0628	0.2004
0.8000	0.1132	0.2855	0.8000	0.0955	0.2560	0.8000	0.0713	0.2185
0.9000	0.1277	0.3074	0.9000	0.1072	0.2757	0.9000	0.0795	0.2345
1.0000	0.1405	0.3251	1.0000	0.1179	0.2916	1.0000	0.0873	0.2481
1.1000	0.1510	0.3377	1.1000	0.1254	0.3024	1.1000	0.0938	0.2577
1.2000	0.1586	0.3450	1.2000	0.1305	0.3077	1.2000	0.0977	0.2623
1.3000	0.1630	0.3466	1.3000	0.1329	0.3077	1.3000	0.0991	0.2618
1.4000	0.1638	0.3422	1.4000	0.1322	0.3021	1.4000	0.0981	0.2564
1.5000	0.1605	0.3313	1.5000	0.1282	0.2908	1.5000	0.0946	0.2460
1.6000	0.1530	0.3135	1.6000	0.1209	0.2734	1.6000	0.0885	0.2302
1.7000	0.1404	0.2879	1.7000	0.1098	0.2493	1.7000	0.0797	0.2089
1.8000	0.1221	0.2533	1.8000	0.0946	0.2178	1.8000	0.0682	0.1817
1.9000	0.0970	0.2078	1.9000	0.0749	0.1778	1.9000	0.0537	0.1481
2.0000	0.0636	0.1485	2.0000	0.0498	0.1277	2.0000	0.0362	0.1074
2.1000	0.0195	0.0688	2.1000	0.0183	0.0644	2.1000	0.0152	0.0586
2.1518	0.0118	0.0118	2.1628	0.0110	0.0110	2.1750	0.0101	0.0101

ROTOR 37 - Continued

RAD = 7.7500 INCHES

R_1 = 0.0086 INCHES

R_2 = 0.0094 INCHES

$L_{(SP)}$ = 1.1226 INCHES

$H_{(SP)}$ = 0.1095 INCHES

GAMMA = 44 DEG 12 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0086	0.0086
0.1000	0.0061	0.0428
0.2000	0.0127	0.0686
0.3000	0.0191	0.0926
0.4000	0.0255	0.1149
0.5000	0.0319	0.1354
0.6000	0.0382	0.1542
0.7000	0.0445	0.1711
0.8000	0.0507	0.1863
0.9000	0.0568	0.1999
1.0000	0.0630	0.2117
1.1000	0.0683	0.2203
1.2000	0.0719	0.2249
1.3000	0.0737	0.2251
1.4000	0.0733	0.2208
1.5000	0.0709	0.2118
1.6000	0.0664	0.1982
1.7000	0.0598	0.1798
1.8000	0.0512	0.1565
1.9000	0.0405	0.1279
2.0000	0.0276	0.0938
2.1000	0.0125	0.0537
2.1837	0.0094	0.0094

RAD = 8.0000 INCHES

R_1 = 0.0082 INCHES

R_2 = 0.0087 INCHES

$L_{(SP)}$ = 1.1257 INCHES

$H_{(SP)}$ = 0.0905 INCHES

GAMMA = 46 DEG 35 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0082	0.0082
0.1000	0.0052	0.0388
0.2000	0.0105	0.0613
0.3000	0.0157	0.0822
0.4000	0.0206	0.1016
0.5000	0.0254	0.1194
0.6000	0.0301	0.1357
0.7000	0.0348	0.1504
0.8000	0.0394	0.1637
0.9000	0.0438	0.1753
1.0000	0.0480	0.1852
1.1000	0.0524	0.1934
1.2000	0.0552	0.1974
1.3000	0.0560	0.1972
1.4000	0.0554	0.1930
1.5000	0.0535	0.1850
1.6000	0.0500	0.1729
1.7000	0.0449	0.1567
1.8000	0.0383	0.1363
1.9000	0.0303	0.1116
2.0000	0.0208	0.0824
2.1000	0.0098	0.0486
2.1887	0.0087	0.0087

RAD = 8.2500 INCHES

R_1 = 0.0078 INCHES

R_2 = 0.0081 INCHES

$L_{(SP)}$ = 1.1339 INCHES

$H_{(SP)}$ = 0.0783 INCHES

GAMMA = 49 DEG 8 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0078	0.0078
0.1000	0.0042	0.0347
0.2000	0.0085	0.0540
0.3000	0.0128	0.0722
0.4000	0.0169	0.0891
0.5000	0.0210	0.1048
0.6000	0.0249	0.1192
0.7000	0.0289	0.1324
0.8000	0.0328	0.1444
0.9000	0.0364	0.1556
1.0000	0.0400	0.1659
1.1000	0.0439	0.1733
1.2000	0.0458	0.1776
1.3000	0.0473	0.1785
1.4000	0.0472	0.1755
1.5000	0.0454	0.1685
1.6000	0.0423	0.1577
1.7000	0.0379	0.1431
1.8000	0.0324	0.1246
1.9000	0.0256	0.1021
2.0000	0.0175	0.0756
2.1000	0.0083	0.0449
2.1895	0.0081	0.0081

ROTOR 37 - Continued

RAD = 8.5000 INCHES

R_1 = 0.0074 INCHES

R_2 = 0.0075 INCHES

$L_{(SP)}$ = 1.1323 INCHES

$H_{(SP)}$ = 0.0624 INCHES

GAMMA = 51 DEG 12 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0074	0.0074
0.1000	0.0022	0.0305
0.2000	0.0047	0.0465
0.3000	0.0072	0.0615
0.4000	0.0098	0.0756
0.5000	0.0124	0.0888
0.6000	0.0151	0.1010
0.7000	0.0179	0.1123
0.8000	0.0209	0.1227
0.9000	0.0239	0.1324
1.0000	0.0271	0.1416
1.1000	0.0304	0.1485
1.2000	0.0333	0.1538
1.3000	0.0349	0.1556
1.4000	0.0352	0.1537
1.5000	0.0344	0.1482
1.6000	0.0323	0.1391
1.7000	0.0292	0.1264
1.8000	0.0250	0.1102
1.9000	0.0197	0.0905
2.0000	0.0135	0.0671
2.1000	0.0065	0.0402
2.1899	0.0075	0.0075

RAD = 8.7500 INCHES

R_1 = 0.0070 INCHES

R_2 = 0.0069 INCHES

$L_{(SP)}$ = 1.1398 INCHES

$H_{(SP)}$ = 0.0496 INCHES

GAMMA = 53 DEG 19 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0070	0.0070
0.1000	0.0015	0.0272
0.2000	0.0031	0.0405
0.3000	0.0047	0.0531
0.4000	0.0064	0.0649
0.5000	0.0081	0.0759
0.6000	0.0098	0.0861
0.7000	0.0117	0.0956
0.8000	0.0137	0.1043
0.9000	0.0158	0.1124
1.0000	0.0181	0.1197
1.1000	0.0205	0.1264
1.2000	0.0230	0.1322
1.3000	0.0248	0.1349
1.4000	0.0255	0.1342
1.5000	0.0251	0.1301
1.6000	0.0239	0.1227
1.7000	0.0217	0.1119
1.8000	0.0187	0.0979
1.9000	0.0148	0.0805
2.0000	0.0103	0.0600
2.1000	0.0050	0.0362
2.1900	0.0069	0.0069

RAD = 9.0000 INCHES

R_1 = 0.0065 INCHES

R_2 = 0.0062 INCHES

$L_{(SP)}$ = 1.1328 INCHES

$H_{(SP)}$ = 0.0368 INCHES

GAMMA = 55 DEG 26 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0065	0.0065
0.1000	-0.0003	0.0237
0.2000	-0.0005	0.0345
0.3000	-0.0004	0.0447
0.4000	-0.0001	0.0542
0.5000	0.0004	0.0631
0.6000	0.0011	0.0715
0.7000	0.0021	0.0793
0.8000	0.0034	0.0866
0.9000	0.0051	0.0934
1.0000	0.0071	0.0997
1.1000	0.0096	0.1056
1.2000	0.0125	0.1111
1.3000	0.0154	0.1149
1.4000	0.0173	0.1155
1.5000	0.0182	0.1130
1.6000	0.0182	0.1073
1.7000	0.0172	0.0986
1.8000	0.0153	0.0868
1.9000	0.0126	0.0722
2.0000	0.0090	0.0545
2.1000	0.0047	0.0339
2.1974	0.0062	0.0062

ROTOR 37 - Concluded

RAD = 9.2500 INCHES

R_1 = 0.0061 INCHES
R_2 = 0.0056 INCHES

$L_{(SP)}$ = 1.1220 INCHES
$H_{(SP)}$ = 0.0270 INCHES
GAMMA = 57 DEG 26 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0061	0.0061
0.1000	-0.0016	0.0209
0.2000	-0.0030	0.0297
0.3000	-0.0041	0.0380
0.4000	-0.0048	0.0458
0.5000	-0.0051	0.0532
0.6000	-0.0051	0.0601
0.7000	-0.0045	0.0665
0.8000	-0.0036	0.0726
0.9000	-0.0021	0.0783
1.0000	-0.0001	0.0836
1.1000	0.0024	0.0886
1.2000	0.0054	0.0937
1.3000	0.0090	0.0977
1.4000	0.0123	0.1000
1.5000	0.0143	0.0992
1.6000	0.0153	0.0954
1.7000	0.0152	0.0885
1.8000	0.0141	0.0786
1.9000	0.0120	0.0656
2.0000	0.0087	0.0496
2.1000	0.0045	0.0304
2.1907	0.0056	0.0056

RAD = 9.6100 INCHES

R_1 = 0.0055 INCHES
R_2 = 0.0047 INCHES

$L_{(SP)}$ = 1.1218 INCHES
$H_{(SP)}$ = 0.0089 INCHES
GAMMA = 60 DEG 21 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0055	0.0055
0.1000	-0.0030	0.0167
0.2000	-0.0058	0.0224
0.3000	-0.0082	0.0277
0.4000	-0.0103	0.0326
0.5000	-0.0120	0.0372
0.6000	-0.0133	0.0414
0.7000	-0.0141	0.0453
0.8000	-0.0143	0.0489
0.9000	-0.0143	0.0523
1.0000	-0.0140	0.0555
1.1000	-0.0124	0.0585
1.2000	-0.0094	0.0615
1.3000	-0.0076	0.0644
1.4000	-0.0074	0.0678
1.5000	0.0003	0.0704
1.6000	0.0006	0.0705
1.7000	0.0030	0.0673
1.8000	0.0046	0.0609
1.9000	0.0043	0.0516
2.0000	0.0032	0.0392
2.1000	0.0017	0.0238
2.1840	0.0047	0.0047

RAD = 9.9330 INCHES

R_1 = 0.0052 INCHES
R_2 = 0.0036 INCHES

$L_{(SP)}$ = 1.1283 INCHES
$H_{(SP)}$ = -0.0199 INCHES
GAMMA = 65 DEG 23 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0052	0.0052
0.1000	-0.0060	0.0107
0.2000	-0.0120	0.0108
0.3000	-0.0176	0.0107
0.4000	-0.0228	0.0104
0.5000	-0.0276	0.0100
0.6000	-0.0318	0.0096
0.7000	-0.0354	0.0093
0.8000	-0.0382	0.0092
0.9000	-0.0404	0.0093
1.0000	-0.0418	0.0098
1.1000	-0.0418	0.0112
1.2000	-0.0401	0.0141
1.3000	-0.0378	0.0175
1.4000	-0.0359	0.0207
1.5000	-0.0333	0.0233
1.6000	-0.0288	0.0258
1.7000	-0.0246	0.0275
1.8000	-0.0207	0.0271
1.9000	-0.0166	0.0240
2.0000	-0.0121	0.0192
2.1000	-0.0066	0.0134
2.2000	0.0004	0.0068
2.2020	0.0036	0.0036

BLADE MANUFACTURING COORDINATES FOR STATOR 37

RAD = 7.4160 INCHES	RAD = 7.6000 INCHES	RAD = 7.7500 INCHES
R_1 = 0.0045 INCHES	R_1 = 0.0046 INCHES	R_1 = 0.0046 INCHES
R_2 = 0.0045 INCHES	R_2 = 0.0045 INCHES	R_2 = 0.0046 INCHES
$L_{(SP)}$ = 0.7510 INCHES	$L_{(SP)}$ = 0.7597 INCHES	$L_{(SP)}$ = 0.7668 INCHES
$H_{(SP)}$ = 0.1083 INCHES	$H_{(SP)}$ = 0.1087 INCHES	$H_{(SP)}$ = 0.1090 INCHES
GAMMA = 25 DEG 48 MIN	GAMMA = 25 DEG 3 MIN	GAMMA = 24 DEG 29 MIN

L	HP	HS	L	HP	HS	L	HP	HS
INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
0.0000	0.0045	0.0045	0.0000	0.0046	0.0046	0.0000	0.0046	0.0046
0.0500	0.0120	0.0274	0.0500	0.0118	0.0279	0.0500	0.0116	0.0283
0.1000	0.0245	0.0458	0.1000	0.0241	0.0467	0.1000	0.0238	0.0474
0.1500	0.0362	0.0628	0.1500	0.0356	0.0641	0.1500	0.0351	0.0651
0.2000	0.0471	0.0785	0.2000	0.0463	0.0801	0.2000	0.0455	0.0813
0.2500	0.0571	0.0929	0.2500	0.0561	0.0947	0.2500	0.0552	0.0962
0.3000	0.0663	0.1059	0.3000	0.0651	0.1080	0.3000	0.0640	0.1097
0.3500	0.0747	0.1178	0.3500	0.0733	0.1201	0.3500	0.0720	0.1219
0.4000	0.0823	0.1284	0.4000	0.0806	0.1308	0.4000	0.0792	0.1328
0.4500	0.0891	0.1378	0.4500	0.0872	0.1404	0.4500	0.0856	0.1424
0.5000	0.0951	0.1462	0.5000	0.0930	0.1488	0.5000	0.0912	0.1508
0.5500	0.1003	0.1533	0.5500	0.0979	0.1559	0.5500	0.0960	0.1580
0.6000	0.1047	0.1590	0.6000	0.1021	0.1617	0.6000	0.0999	0.1638
0.6500	0.1081	0.1636	0.6500	0.1053	0.1662	0.6500	0.1030	0.1683
0.7000	0.1105	0.1666	0.7000	0.1076	0.1693	0.7000	0.1052	0.1714
0.7500	0.1119	0.1683	0.7500	0.1089	0.1710	0.7500	0.1064	0.1731
0.8000	0.1122	0.1684	0.8000	0.1092	0.1712	0.8000	0.1067	0.1734
0.8500	0.1114	0.1671	0.8500	0.1085	0.1699	0.8500	0.1060	0.1722
0.9000	0.1096	0.1642	0.9000	0.1068	0.1672	0.9000	0.1044	0.1696
0.9500	0.1066	0.1599	0.9500	0.1040	0.1631	0.9500	0.1018	0.1656
1.0000	0.1026	0.1541	1.0000	0.1002	0.1574	1.0000	0.0982	0.1601
1.0500	0.0974	0.1467	1.0500	0.0954	0.1503	1.0500	0.0936	0.1532
1.1000	0.0911	0.1378	1.1000	0.0896	0.1417	1.1000	0.0881	0.1447
1.1500	0.0836	0.1273	1.1500	0.0826	0.1315	1.1500	0.0815	0.1348
1.2000	0.0750	0.1152	1.2000	0.0746	0.1197	1.2000	0.0740	0.1233
1.2500	0.0652	0.1015	1.2500	0.0654	0.1063	1.2500	0.0654	0.1102
1.3000	0.0541	0.0860	1.3000	0.0552	0.0913	1.3000	0.0557	0.0955
1.3500	0.0418	0.0687	1.3500	0.0438	0.0746	1.3500	0.0450	0.0792
1.4000	0.0283	0.0496	1.4000	0.0312	0.0560	1.4000	0.0332	0.0611
1.4500	0.0133	0.0286	1.4500	0.0174	0.0357	1.4500	0.0202	0.0412
1.4965	0.0045	0.0045	1.5000	0.0023	0.0133	1.5000	0.0061	0.0194
			1.5126	0.0045	0.0045	1.5258	0.0046	0.0046

STATOR 37 - Continued

RAD = 8.0000 INCHES

R_1 = 0.0047 INCHES

R_2 = 0.0046 INCHES

$L_{(SP)}$ = 0.7782 INCHES

$H_{(SP)}$ = 0.1094 INCHES

GAMMA = 23 DEG 40 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0047	0.0047
0.0500	0.0113	0.0289
0.1000	0.0230	0.0485
0.1500	0.0340	0.0666
0.2000	0.0441	0.0832
0.2500	0.0535	0.0985
0.3000	0.0620	0.1123
0.3500	0.0697	0.1247
0.4000	0.0766	0.1359
0.4500	0.0827	0.1457
0.5000	0.0880	0.1542
0.5500	0.0926	0.1614
0.6000	0.0963	0.1674
0.6500	0.0992	0.1720
0.7000	0.1012	0.1752
0.7500	0.1023	0.1770
0.8000	0.1026	0.1774
0.8500	0.1020	0.1764
0.9000	0.1006	0.1740
0.9500	0.0982	0.1702
1.0000	0.0949	0.1650
1.0500	0.0908	0.1583
1.1000	0.0857	0.1502
1.1500	0.0798	0.1406
1.2000	0.0729	0.1295
1.2500	0.0651	0.1169
1.3000	0.0563	0.1027
1.3500	0.0466	0.0869
1.4000	0.0359	0.0694
1.4500	0.0242	0.0502
1.5000	0.0116	0.0293
1.5477	0.0046	0.0046

RAD = 8.2500 INCHES

R_1 = 0.0047 INCHES

R_2 = 0.0047 INCHES

$L_{(SP)}$ = 0.7895 INCHES

$H_{(SP)}$ = 0.1107 INCHES

GAMMA = 23 DEG 6 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0047	0.0047
0.0500	0.0109	0.0295
0.1000	0.0224	0.0497
0.1500	0.0331	0.0683
0.2000	0.0429	0.0854
0.2500	0.0520	0.1011
0.3000	0.0602	0.1153
0.3500	0.0677	0.1281
0.4000	0.0744	0.1395
0.4500	0.0803	0.1495
0.5000	0.0854	0.1583
0.5500	0.0898	0.1657
0.6000	0.0934	0.1719
0.6500	0.0962	0.1767
0.7000	0.0981	0.1801
0.7500	0.0993	0.1821
0.8000	0.0996	0.1827
0.8500	0.0991	0.1819
0.9000	0.0978	0.1797
0.9500	0.0957	0.1761
1.0000	0.0927	0.1711
1.0500	0.0889	0.1647
1.1000	0.0843	0.1569
1.1500	0.0788	0.1476
1.2000	0.0725	0.1368
1.2500	0.0653	0.1245
1.3000	0.0573	0.1107
1.3500	0.0484	0.0953
1.4000	0.0386	0.0783
1.4500	0.0279	0.0596
1.5000	0.0163	0.0392
1.5500	0.0038	0.0170
1.5698	0.0047	0.0047

RAD = 8.5000 INCHES

R_1 = 0.0048 INCHES

R_2 = 0.0048 INCHES

$L_{(SP)}$ = 0.8006 INCHES

$H_{(SP)}$ = 0.1123 INCHES

GAMMA = 22 DEG 39 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0048	0.0048
0.0500	0.0106	0.0302
0.1000	0.0217	0.0509
0.1500	0.0321	0.0700
0.2000	0.0416	0.0876
0.2500	0.0504	0.1037
0.3000	0.0585	0.1183
0.3500	0.0657	0.1315
0.4000	0.0722	0.1433
0.4500	0.0780	0.1537
0.5000	0.0830	0.1627
0.5500	0.0873	0.1704
0.6000	0.0908	0.1768
0.6500	0.0935	0.1818
0.7000	0.0955	0.1855
0.7500	0.0967	0.1877
0.8000	0.0971	0.1886
0.8500	0.0968	0.1881
0.9000	0.0957	0.1862
0.9500	0.0938	0.1828
1.0000	0.0911	0.1781
1.0500	0.0876	0.1720
1.1000	0.0834	0.1644
1.1500	0.0783	0.1554
1.2000	0.0725	0.1449
1.2500	0.0659	0.1329
1.3000	0.0585	0.1194
1.3500	0.0502	0.1044
1.4000	0.0412	0.0877
1.4500	0.0313	0.0693
1.5000	0.0206	0.0493
1.5500	0.0090	0.0275
1.5920	0.0048	0.0048

STATOR 37 - Continued

RAD	=	0.7500	INCHES	RAD	=	9.0000	INCHES
R_1	=	0.0048	INCHES	R_1	=	0.0049	INCHES
R_2	=	0.0048	INCHES	R_2	=	0.0049	INCHES
$L_{(SP)}$	=	0.8114	INCHES	$L_{(SP)}$	=	0.8215	INCHES
$H_{(SP)}$	=	0.1142	INCHES	$H_{(SP)}$	=	0.1205	INCHES
GAMMA	=	22 DEG	16 MIN	GAMMA	=	22 DEG	24 MIN

L	HP	HS	L	HP	HS
INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
0.0000	0.0048	0.0048	0.0000	0.0049	0.0049
0.0500	0.0103	0.0309	0.0500	0.0105	0.0324
0.1000	0.0211	0.0523	0.1000	0.0216	0.0551
0.1500	0.0312	0.0720	0.1500	0.0319	0.0760
0.2000	0.0405	0.0901	0.2000	0.0415	0.0952
0.2500	0.0490	0.1066	0.2500	0.0502	0.1127
0.3000	0.0569	0.1217	0.3000	0.0583	0.1286
0.3500	0.0639	0.1352	0.3500	0.0656	0.1430
0.4000	0.0703	0.1474	0.4000	0.0721	0.1559
0.4500	0.0759	0.1581	0.4500	0.0779	0.1673
0.5000	0.0808	0.1675	0.5000	0.0830	0.1772
0.5500	0.0849	0.1755	0.5500	0.0874	0.1857
0.6000	0.0884	0.1821	0.6000	0.0910	0.1928
0.6500	0.0911	0.1874	0.6500	0.0939	0.1985
0.7000	0.0931	0.1913	0.7000	0.0960	0.2028
0.7500	0.0943	0.1938	0.7500	0.0974	0.2056
0.8000	0.0949	0.1949	0.8000	0.0981	0.2071
0.8500	0.0946	0.1947	0.8500	0.0981	0.2071
0.9000	0.0937	0.1930	0.9000	0.0973	0.2054
0.9500	0.0920	0.1899	0.9500	0.0958	0.20[illegible]
1.0000	0.0896	0.1855	1.0000	0.0935	0.1985
1.0500	0.0864	0.1796	1.0500	0.0905	0.1927
1.1000	0.0825	0.1723	1.1000	0.0867	0.1855
1.1500	0.0779	0.1636	1.1500	0.0822	0.1768
1.2000	0.0725	0.1534	1.2000	0.0770	0.1666
1.2500	0.0664	0.1417	1.2500	0.0710	0.1549
1.3000	0.0595	0.1284	1.3000	0.0642	0.1416
1.3500	0.0518	0.1137	1.3500	0.0567	0.1267
1.4000	0.0434	0.0973	1.4000	0.0484	0.1102
1.4500	0.0343	0.0793	1.4500	0.0394	0.0920
1.5000	0.0243	0.0595	1.5000	0.0295	0.0720
1.5500	0.0136	0.0381	1.5500	0.0189	0.0502
1.6000	0.0021	0.0148	1.6000	0.0075	0.0265
1.6141	0.0048	0.0048	1.6365	0.0049	0.0049

STATOR 37 - Concluded

RAD = 9.4000 INCHES	RAD = 9.5490 INCHES
R_1 = 0.0050 INCHES	R_1 = 0.0050 INCHES
R_2 = 0.0050 INCHES	R_2 = 0.0051 INCHES
$L_{(SP)}$ = 0.8377 INCHES	$L_{(SP)}$ = 0.8436 INCHES
$H_{(SP)}$ = 0.1261 INCHES	$H_{(SP)}$ = 0.1286 INCHES
GAMMA = 22 DEG 16 MIN	GAMMA = 22 DEG 20 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0050	0.0050	0.0000	0.0050	0.0050
0.0500	0.0103	0.0340	0.0500	0.0102	0.0348
0.1000	0.0211	0.0581	0.1000	0.0210	0.0595
0.1500	0.0312	0.0803	0.1500	0.0311	0.0823
0.2000	0.0406	0.1007	0.2000	0.0405	0.1032
0.2500	0.0492	0.1194	0.2500	0.0491	0.1223
0.3000	0.0571	0.1363	0.3000	0.0570	0.1397
0.3500	0.0643	0.1516	0.3500	0.0642	0.1554
0.4000	0.0708	0.1654	0.4000	0.0707	0.1694
0.4500	0.0766	0.1775	0.4500	0.0765	0.1819
0.5000	0.0817	0.1881	0.5000	0.0815	0.1927
0.5500	0.0860	0.1972	0.5500	0.0859	0.2020
0.6000	0.0897	0.2049	0.6000	0.0896	0.2099
0.6500	0.0926	0.2111	0.6500	0.0926	0.2162
0.7000	0.0949	0.2158	0.7000	0.0949	0.2211
0.7500	0.0965	0.2190	0.7500	0.0965	0.2245
0.8000	0.0973	0.2209	0.8000	0.0974	0.2265
0.8500	0.0975	0.2213	0.8500	0.0976	0.2270
0.9000	0.0969	0.2202	0.9000	0.0971	0.2261
0.9500	0.0957	0.2177	0.9500	0.0960	0.2237
1.0000	0.0937	0.2137	1.0000	0.0942	0.2199
1.0500	0.0910	0.2083	1.0500	0.0917	0.2147
1.1000	0.0877	0.2014	1.1000	0.0884	0.2077
1.1500	0.0836	0.1931	1.1500	0.0846	0.1997
1.2000	0.0788	0.1832	1.2000	0.0800	0.1900
1.2500	0.0734	0.1718	1.2500	0.0747	0.1787
1.3000	0.0672	0.1588	1.3000	0.0687	0.1658
1.3500	0.0603	0.1442	1.3500	0.0621	0.1513
1.4000	0.0527	0.1279	1.4000	0.0547	0.1352
1.4500	0.0444	0.1100	1.4500	0.0466	0.1174
1.5000	0.0353	0.0903	1.5000	0.0378	0.0978
1.5500	0.0256	0.0687	1.5500	0.0283	0.0763
1.6000	0.0151	0.0453	1.6000	0.0180	0.0530
1.6500	0.0039	0.0199	1.6500	0.0070	0.0276
1.6722	0.0050	0.0050	1.6860	0.0051	0.0051

BLADE MANUFACTURING COORDINATES FOR ROTOR 38

RAD = 7.0060 INCHES	RAD = 7.1450 INCHES	RAD = 7.3050 INCHES
R_1 = 0.0075 INCHES	R_1 = 0.0073 INCHES	R_1 = 0.0071 INCHES
R_2 = 0.0083 INCHES	R_2 = 0.0080 INCHES	R_2 = 0.0078 INCHES
$L_{(SP)}$ = 0.8442 INCHES	$L_{(SP)}$ = 0.8452 INCHES	$L_{(SP)}$ = 0.8460 INCHES
$H_{(SP)}$ = 0.1281 INCHES	$H_{(SP)}$ = 0.1186 INCHES	$H_{(SP)}$ = 0.1070 INCHES
GAMMA = 38 DEG 55 MIN	GAMMA = 39 DEG 41 MIN	GAMMA = 40 DEG 51 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0075	0.0075	0.0000	0.0073	0.0073	0.0000	0.0071	0.0071
0.0500	0.0047	0.0320	0.0500	0.0044	0.0308	0.0500	0.0039	0.0292
0.1000	0.0103	0.0505	0.1000	0.0097	0.0483	0.1000	0.0085	0.0456
0.1500	0.0159	0.0683	0.1500	0.0149	0.0652	0.1500	0.0131	0.0612
0.2000	0.0215	0.0853	0.2000	0.0202	0.0812	0.2000	0.0177	0.0761
0.2500	0.0271	0.1016	0.2500	0.0254	0.0966	0.2500	0.0223	0.0904
0.3000	0.0328	0.1171	0.3000	0.0307	0.1113	0.3000	0.0269	0.1039
0.3500	0.0385	0.1318	0.3500	0.0360	0.1252	0.3500	0.0315	0.1168
0.4000	0.0443	0.1459	0.4000	0.0413	0.1385	0.4000	0.0361	0.1289
0.4500	0.0501	0.1592	0.4500	0.0466	0.1510	0.4500	0.0407	0.1404
0.5000	0.0559	0.1718	0.5000	0.0518	0.1627	0.5000	0.0454	0.1513
0.5500	0.0618	0.1841	0.5500	0.0570	0.1737	0.5500	0.0501	0.1616
0.6000	0.0678	0.1953	0.6000	0.0623	0.1840	0.6000	0.0547	0.1711
0.6500	0.0739	0.2053	0.6500	0.0678	0.1938	0.6500	0.0592	0.1798
0.7000	0.0798	0.2144	0.7000	0.0738	0.2030	0.7000	0.0634	0.1876
0.7500	0.0850	0.2220	0.7500	0.0789	0.2104	0.7500	0.0677	0.1946
0.8000	0.0895	0.2280	0.8000	0.0824	0.2159	0.8000	0.0717	0.2002
0.8500	0.0932	0.2323	0.8500	0.0851	0.2197	0.8500	0.0748	0.2042
0.9000	0.0959	0.2348	0.9000	0.0873	0.2219	0.9000	0.0769	0.2064
0.9500	0.0977	0.2356	0.9500	0.0889	0.2225	0.9500	0.0780	0.2067
1.0000	0.0985	0.2346	1.0000	0.0895	0.2213	1.0000	0.0782	0.2054
1.0500	0.0982	0.2317	1.0500	0.0891	0.2183	1.0500	0.0777	0.2024
1.1000	0.0969	0.2268	1.1000	0.0876	0.2134	1.1000	0.0764	0.1978
1.1500	0.0944	0.2199	1.1500	0.0851	0.2066	1.1500	0.0742	0.1913
1.2000	0.0908	0.2110	1.2000	0.0816	0.1979	1.2000	0.0711	0.1831
1.2500	0.0860	0.1998	1.2500	0.0771	0.1871	1.2500	0.0670	0.1729
1.3000	0.0798	0.1863	1.3000	0.0714	0.1741	1.3000	0.0620	0.1608
1.3500	0.0723	0.1703	1.3500	0.0645	0.1589	1.3500	0.0560	0.1465
1.4000	0.0633	0.1515	1.4000	0.0564	0.1412	1.4000	0.0489	0.1301
1.4500	0.0527	0.1297	1.4500	0.0470	0.1208	1.4500	0.0407	0.1114
1.5000	0.0404	0.1044	1.5000	0.0361	0.0975	1.5000	0.0314	0.0901
1.5500	0.0261	0.0750	1.5500	0.0237	0.0707	1.5500	0.0209	0.0661
1.6000	0.0096	0.0406	1.6000	0.0096	0.0401	1.6000	0.0091	0.0389
1.6362	0.0083	0.0083	1.6405	0.0080	0.0080	1.6442	0.0078	0.0078

ROTOR 38 - Continued

RAD = 7.3500 INCHES

R_1 = 0.0071 INCHES

R_2 = 0.0077 INCHES

$L_{(SP)}$ = 0.8462 INCHES

$H_{(SP)}$ = 0.1036 INCHES

GAMMA = 41 DEG 13 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0071	0.0071
0.0500	0.0037	0.0288
0.1000	0.0081	0.0447
0.1500	0.0125	0.0600
0.2000	0.0169	0.0746
0.2500	0.0213	0.0885
0.3000	0.0257	0.1017
0.3500	0.0301	0.1143
0.4000	0.0344	0.1261
0.4500	0.0388	0.1374
0.5000	0.0433	0.1479
0.5500	0.0477	0.1579
0.6000	0.0522	0.1671
0.6500	0.0565	0.1756
0.7000	0.0606	0.1833
0.7500	0.0646	0.1901
0.8000	0.0685	0.1957
0.8500	0.0716	0.1996
0.9000	0.0736	0.2017
0.9500	0.0747	0.2021
1.0000	0.0749	0.2008
1.0500	0.0745	0.1979
1.1000	0.0732	0.1933
1.1500	0.0711	0.1870
1.2000	0.0681	0.1789
1.2500	0.0642	0.1690
1.3000	0.0594	0.1571
1.3500	0.0536	0.1431
1.4000	0.0468	0.1271
1.4500	0.0390	0.1088
1.5000	0.0301	0.0881
1.5500	0.0201	0.0648
1.6000	0.0089	0.0385
1.6451	0.0077	0.0077

RAD = 7.5000 INCHES

R_1 = 0.0069 INCHES

R_2 = 0.0074 INCHES

$L_{(SP)}$ = 0.8469 INCHES

$H_{(SP)}$ = 0.0921 INCHES

GAMMA = 42 DEG 36 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0069	0.0069
0.0500	0.0031	0.0273
0.1000	0.0067	0.0419
0.1500	0.0103	0.0560
0.2000	0.0139	0.0693
0.2500	0.0176	0.0821
0.3000	0.0212	0.0942
0.3500	0.0249	0.1057
0.4000	0.0286	0.1166
0.4500	0.0323	0.1268
0.5000	0.0359	0.1365
0.5500	0.0396	0.1454
0.6000	0.0433	0.1538
0.6500	0.0470	0.1615
0.7000	0.0507	0.1688
0.7500	0.0544	0.1751
0.8000	0.0577	0.1803
0.8500	0.0604	0.1839
0.9000	0.0623	0.1860
0.9500	0.0634	0.1865
1.0000	0.0639	0.1855
1.0500	0.0636	0.1828
1.1000	0.0625	0.1786
1.1500	0.0607	0.1728
1.2000	0.0582	0.1652
1.2500	0.0549	0.1560
1.3000	0.0507	0.1450
1.3500	0.0458	0.1321
1.4000	0.0400	0.1174
1.4500	0.0334	0.1006
1.5000	0.0259	0.0817
1.5500	0.0175	0.0606
1.6000	0.0081	0.0370
1.6480	0.0074	0.0074

RAD = 7.7500 INCHES

R_1 = 0.0066 INCHES

R_2 = 0.0070 INCHES

$L_{(SP)}$ = 0.8485 INCHES

$H_{(SP)}$ = 0.0739 INCHES

GAMMA = 45 DEG 6 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0066	0.0066
0.0500	0.0020	0.0248
0.1000	0.0043	0.0373
0.1500	0.0067	0.0492
0.2000	0.0090	0.0607
0.2500	0.0115	0.0715
0.3000	0.0139	0.0819
0.3500	0.0164	0.0917
0.4000	0.0189	0.1009
0.4500	0.0215	0.1097
0.5000	0.0241	0.1178
0.5500	0.0267	0.1254
0.6000	0.0294	0.1325
0.6500	0.0321	0.1391
0.7000	0.0347	0.1453
0.7500	0.0374	0.1508
0.8000	0.0405	0.1554
0.8500	0.0425	0.1588
0.9000	0.0442	0.1609
0.9500	0.0455	0.1617
1.0000	0.0462	0.1610
1.0500	0.0463	0.1589
1.1000	0.0457	0.1553
1.1500	0.0445	0.1502
1.2000	0.0427	0.1437
1.2500	0.0403	0.1357
1.3000	0.0374	0.1262
1.3500	0.0338	0.1151
1.4000	0.0296	0.1024
1.4500	0.0248	0.0881
1.5000	0.0193	0.0720
1.5500	0.0133	0.0541
1.6000	0.0065	0.0343
1.6500	0.0020	0.0120
1.6521	0.0070	0.0070

ROTOR 38 - Continued

RAD = 8.0000 INCHES

R_1 = 0.0063 INCHES
R_2 = 0.0066 INCHES

$L_{(SP)}$ = 0.8516 INCHES
$H_{(SP)}$ = 0.0589 INCHES
GAMMA = 47 DEG 33 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0063	0.0063
0.0500	0.0013	0.0225
0.1000	0.0028	0.0331
0.1500	0.0043	0.0433
0.2000	0.0059	0.0531
0.2500	0.0075	0.0624
0.3000	0.0091	0.0712
0.3500	0.0108	0.0796
0.4000	0.0125	0.0876
0.4500	0.0142	0.0952
0.5000	0.0160	0.1023
0.5500	0.0179	0.1090
0.6000	0.0198	0.1152
0.6500	0.0217	0.1209
0.7000	0.0237	0.1262
0.7500	0.0257	0.1310
0.8000	0.0277	0.1353
0.8500	0.0298	0.1387
0.9000	0.0312	0.1406
0.9500	0.0319	0.1411
1.0000	0.0323	0.1404
1.0500	0.0323	0.1384
1.1000	0.0319	0.1353
1.1500	0.0311	0.1309
1.2000	0.0299	0.1252
1.2500	0.0282	0.1181
1.3000	0.0261	0.1098
1.3500	0.0236	0.1002
1.4000	0.0207	0.0892
1.4500	0.0173	0.0768
1.5000	0.0136	0.0631
1.5500	0.0094	0.0479
1.6000	0.0048	0.0312
1.6500	0.0003	0.0130
1.6547	0.0066	0.0066

RAD = 8.2500 INCHES

R_1 = 0.0061 INCHES
R_2 = 0.0062 INCHES

$L_{(SP)}$ = 0.8583 INCHES
$H_{(SP)}$ = 0.0477 INCHES
GAMMA = 49 DEG 46 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0061	0.0061
0.0500	0.0010	0.0206
0.1000	0.0022	0.0297
0.1500	0.0033	0.0385
0.2000	0.0045	0.0469
0.2500	0.0056	0.0550
0.3000	0.0068	0.0626
0.3500	0.0080	0.0699
0.4000	0.0094	0.0769
0.4500	0.0106	0.0834
0.5000	0.0117	0.0896
0.5500	0.0125	0.0954
0.6000	0.0136	0.1009
0.6500	0.0153	0.1060
0.7000	0.0182	0.1110
0.7500	0.0205	0.1156
0.8000	0.0197	0.1193
0.8500	0.0218	0.1223
0.9000	0.0231	0.1242
0.9500	0.0232	0.1250
1.0000	0.0230	0.1247
1.0500	0.0228	0.1232
1.1000	0.0226	0.1205
1.1500	0.0221	0.1166
1.2000	0.0213	0.1116
1.2500	0.0200	0.1054
1.3000	0.0185	0.0980
1.3500	0.0166	0.0895
1.4000	0.0145	0.0797
1.4500	0.0121	0.0687
1.5000	0.0095	0.0566
1.5500	0.0066	0.0431
1.6000	0.0034	0.0284
1.6500	0.0001	0.0124
1.6551	0.0062	0.0062

RAD = 8.5000 INCHES

R_1 = 0.0058 INCHES
R_2 = 0.0058 INCHES

$L_{(SP)}$ = 0.8600 INCHES
$H_{(SP)}$ = 0.0369 INCHES
GAMMA = 51 DEG 52 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0058	0.0058
0.0500	0.0003	0.0186
0.1000	0.0007	0.0263
0.1500	0.0011	0.0337
0.2000	0.0016	0.0407
0.2500	0.0021	0.0475
0.3000	0.0027	0.0540
0.3500	0.0033	0.0602
0.4000	0.0040	0.0662
0.4500	0.0048	0.0718
0.5000	0.0056	0.0771
0.5500	0.0065	0.0822
0.6000	0.0074	0.0870
0.6500	0.0084	0.0915
0.7000	0.0095	0.0960
0.7500	0.0106	0.1001
0.8000	0.0118	0.1037
0.8500	0.0131	0.1066
0.9000	0.0142	0.1090
0.9500	0.0150	0.1103
1.0000	0.0156	0.1105
1.0500	0.0159	0.1095
1.1000	0.0159	0.1075
1.1500	0.0156	0.1043
1.2000	0.0151	0.1001
1.2500	0.0144	0.0947
1.3000	0.0134	0.0883
1.3500	0.0121	0.0807
1.4000	0.0107	0.0720
1.4500	0.0090	0.0623
1.5000	0.0070	0.0513
1.5500	0.0049	0.0393
1.6000	0.0025	0.0261
1.6500	0.0001	0.0117
1.6550	0.0058	0.0058

ROTOR 38 - Continued

RAD = 8.7500 INCHES
R₁ = 0.0055 INCHES
R₂ = 0.0055 INCHES
L(SP) = 0.8595 INCHES
H(SP) = 0.0276 INCHES
GAMMA = 53 DEG 49 MIN

RAD = 9.0000 INCHES
R₁ = 0.0052 INCHES
R₂ = 0.0051 INCHES
L(SP) = 0.8586 INCHES
H(SP) = 0.0173 INCHES
GAMMA = 56 DEG 1 MIN

RAD = 9.2500 INCHES
R₁ = 0.0049 INCHES
R₂ = 0.0047 INCHES
L(SP) = 0.6549 INCHES
H(SP) = 0.0078 INCHES
GAMMA = 58 DEG 20 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0055	0.0055	0.0000	0.0052	0.0052	0.0000	0.0049	0.0049
0.0500	-0.0003	0.0169	0.0500	-0.0011	0.0151	0.0500	-0.0019	0.0134
0.1000	-0.0006	0.0233	0.1000	-0.0021	0.0202	0.1000	-0.0037	0.0173
0.1500	-0.0008	0.0295	0.1500	-0.0031	0.0251	0.1500	-0.0055	0.0210
0.2000	-0.0010	0.0355	0.2000	-0.0039	0.0299	0.2000	-0.0070	0.0246
0.2500	-0.0010	0.0412	0.2500	-0.0046	0.0344	0.2500	-0.0083	0.0281
0.3000	-0.0010	0.0466	0.3000	-0.0052	0.0388	0.3000	-0.0095	0.0315
0.3500	-0.0008	0.0519	0.3500	-0.0056	0.0431	0.3500	-0.0105	0.0348
0.4000	-0.0006	0.0569	0.4000	-0.0059	0.0471	0.4000	-0.0113	0.0380
0.4500	-0.0002	0.0617	0.4500	-0.0061	0.0510	0.4500	-0.0119	0.0410
0.5000	0.0002	0.0663	0.5000	-0.0061	0.0548	0.5000	-0.0123	0.0440
0.5500	0.0008	0.0706	0.5500	-0.0059	0.0583	0.5500	-0.0125	0.0469
0.6000	0.0014	0.0748	0.6000	-0.0056	0.0618	0.6000	-0.0125	0.0497
0.6500	0.0022	0.0787	0.6500	-0.0052	0.0651	0.6500	-0.0123	0.0524
0.7000	0.0030	0.0824	0.7000	-0.0046	0.0682	0.7000	-0.0118	0.0550
0.7500	0.0040	0.0860	0.7500	-0.0036	0.0712	0.7500	-0.0112	0.0575
0.8000	0.0051	0.0893	0.8000	-0.0028	0.0741	0.8000	-0.0103	0.0600
0.8500	0.0063	0.0923	0.8500	-0.0016	0.0770	0.8500	-0.0092	0.0625
0.9000	0.0075	0.0950	0.9000	-0.0003	0.0796	0.9000	-0.0078	0.0650
0.9500	0.0086	0.0967	0.9500	0.0010	0.0818	0.9500	-0.0062	0.0671
1.0000	0.0095	0.0974	1.0000	0.0023	0.0830	1.0000	-0.0044	0.0691
1.0500	0.0101	0.0970	1.0500	0.0033	0.0833	1.0500	-0.0029	0.0701
1.1000	0.0104	0.0956	1.1000	0.0041	0.0825	1.1000	-0.0015	0.0702
1.1500	0.0105	0.0931	1.1500	0.0046	0.0808	1.1500	-0.0004	0.0693
1.2000	0.0104	0.0895	1.2000	0.0049	0.0781	1.2000	0.0005	0.0675
1.2500	0.0101	0.0850	1.2500	0.0051	0.0744	1.2500	0.0012	0.0648
1.3000	0.0095	0.0794	1.3000	0.0051	0.0698	1.3000	0.0017	0.0611
1.3500	0.0087	0.0727	1.3500	0.0049	0.0642	1.3500	0.0020	0.0566
1.4000	0.0077	0.0651	1.4000	0.0045	0.0576	1.4000	0.0022	0.0511
1.4500	0.0066	0.0563	1.4500	0.0039	0.0501	1.4500	0.0021	0.0447
1.5000	0.0052	0.0466	1.5000	0.0032	0.0416	1.5000	0.0019	0.0374
1.5500	0.0036	0.0358	1.5500	0.0023	0.0322	1.5500	0.0015	0.0291
1.6000	0.0019	0.0239	1.6000	0.0012	0.0218	1.6000	0.0009	0.0199
1.6500	0.0000	0.0110	1.6500	0.0000	0.0104	1.6500	0.0000	0.0097
1.6551	0.0055	0.0055	1.6557	0.0051	0.0051	1.6560	0.0047	0.0047

ROTOR 38 - Continued

RAD = 9.5000 INCHES

R_1 = 0.0046 INCHES

R_2 = 0.0043 INCHES

$L_{(SP)}$ = 0.8528 INCHES

$H_{(SP)}$ = -0.0004 INCHES

GAMMA = 60 DEG 45 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0046	0.0046
0.0500	-0.0025	0.0118
0.1000	-0.0049	0.0146
0.1500	-0.0072	0.0173
0.2000	-0.0093	0.0200
0.2500	-0.0112	0.0225
0.3000	-0.0128	0.0250
0.3500	-0.0142	0.0275
0.4000	-0.0154	0.0298
0.4500	-0.0164	0.0321
0.5000	-0.0171	0.0344
0.5500	-0.0176	0.0366
0.6000	-0.0179	0.0387
0.6500	-0.0179	0.0409
0.7000	-0.0176	0.0430
0.7500	-0.0171	0.0451
0.8000	-0.0164	0.0471
0.8500	-0.0153	0.0492
0.9000	-0.0140	0.0512
0.9500	-0.0125	0.0532
1.0000	-0.0106	0.0554
1.0500	-0.0084	0.0575
1.1000	-0.0063	0.0590
1.1500	-0.0046	0.0593
1.2000	-0.0031	0.0587
1.2500	-0.0017	0.0571
1.3000	-0.0007	0.0546
1.3500	0.0002	0.0510
1.4000	0.0007	0.0465
1.4500	0.0010	0.0408
1.5000	0.0011	0.0342
1.5500	0.0009	0.0265
1.6000	0.0006	0.0177
1.6500	0.0022	0.0063
1.6505	0.0043	0.0043

RAD = 9.6500 INCHES

R_1 = 0.0044 INCHES

R_2 = 0.0040 INCHES

$L_{(SP)}$ = 0.8546 INCHES

$H_{(SP)}$ = -0.0056 INCHES

GAMMA = 62 DEG 16 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0044	0.0044
0.0500	-0.0027	0.0108
0.1000	-0.0055	0.0129
0.1500	-0.0081	0.0150
0.2000	-0.0104	0.0170
0.2500	-0.0125	0.0189
0.3000	-0.0144	0.0209
0.3500	-0.0160	0.0227
0.4000	-0.0174	0.0246
0.4500	-0.0186	0.0264
0.5000	-0.0195	0.0282
0.5500	-0.0203	0.0300
0.6000	-0.0207	0.0318
0.6500	-0.0209	0.0335
0.7000	-0.0207	0.0353
0.7500	-0.0203	0.0371
0.8000	-0.0197	0.0389
0.8500	-0.0191	0.0408
0.9000	-0.0184	0.0426
0.9500	-0.0170	0.0446
1.0000	-0.0145	0.0465
1.0500	-0.0117	0.0484
1.1000	-0.0115	0.0503
1.1500	-0.0084	0.0520
1.2000	-0.0054	0.0525
1.2500	-0.0040	0.0516
1.3000	-0.0033	0.0495
1.3500	-0.0026	0.0465
1.4000	-0.0018	0.0424
1.4500	-0.0010	0.0374
1.5000	-0.0005	0.0313
1.5500	-0.0002	0.0241
1.6000	-0.0001	0.0158
1.6462	0.0040	0.0040

RAD = 9.7490 INCHES

R_1 = 0.0043 INCHES

R_2 = 0.0038 INCHES

$L_{(SP}$ = 0.8573 INCHES

$H_{(SP)}$ = -0.0096 INCHES

GAMMA = 63 DEG 19 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0043	0.0043
0.0500	-0.0029	0.0101
0.1000	-0.0058	0.0117
0.1500	-0.0086	0.0132
0.2000	-0.0111	0.0148
0.2500	-0.0133	0.0163
0.3000	-0.0154	0.0178
0.3500	-0.0172	0.0192
0.4000	-0.0188	0.0207
0.4500	-0.0201	0.0222
0.5000	-0.0212	0.0236
0.5500	-0.0220	0.0251
0.6000	-0.0226	0.0266
0.6500	-0.0229	0.0281
0.7000	-0.0230	0.0296
0.7500	-0.0228	0.0312
0.8000	-0.0224	0.0329
0.8500	-0.0216	0.0346
0.9000	-0.0206	0.0363
0.9500	-0.0193	0.0382
1.0000	-0.0179	0.0401
1.0500	-0.0162	0.0421
1.1000	-0.0140	0.0442
1.1500	-0.0117	0.0461
1.2000	-0.0098	0.0469
1.2500	-0.0082	0.0464
1.3000	-0.0067	0.0448
1.3500	-0.0055	0.0422
1.4000	-0.0044	0.0386
1.4500	-0.0034	0.0340
1.5000	-0.0025	0.0284
1.5500	-0.0016	0.0218
1.6000	-0.0007	0.0143
1.6429	0.0038	0.0038

ROTOR 38 - Continued

RAD = 9.8000 INCHES

R_1 = 0.0042 INCHES
R_2 = 0.0038 INCHES

$L_{(SP)}$ = 0.8591 INCHES
$H_{(SP)}$ = -0.0119 INCHES
GAMMA = 63 DEG 52 MIN

RAD = 9.8500 INCHES

R_1 = 0.0042 INCHES
R_2 = 0.0037 INCHES

$L_{(SP)}$ = 0.8612 INCHES
$H_{(SP)}$ = -0.0144 INCHES
GAMMA = 64 DEG 24 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0042	0.0042	0.0000	0.0042	0.0042
0.0500	-0.0030	0.0097	0.0500	-0.0031	0.0092
0.1000	-0.0060	0.0110	0.1000	-0.0062	0.0102
0.1500	-0.0088	0.0122	0.1500	-0.0091	0.0112
0.2000	-0.0114	0.0135	0.2000	-0.0118	0.0122
0.2500	-0.0138	0.0148	0.2500	-0.0142	0.0132
0.3000	-0.0159	0.0160	0.3000	-0.0165	0.0142
0.3500	-0.0178	0.0172	0.3500	-0.0184	0.0152
0.4000	-0.0195	0.0185	0.4000	-0.0202	0.0162
0.4500	-0.0209	0.0197	0.4500	-0.0217	0.0173
0.5000	-0.0221	0.0210	0.5000	-0.0230	0.0183
0.5500	-0.0230	0.0223	0.5500	-0.0240	0.0194
0.6000	-0.0237	0.0237	0.6000	-0.0248	0.0206
0.6500	-0.0241	0.0250	0.6500	-0.0253	0.0218
0.7000	-0.0242	0.0264	0.7000	-0.0255	0.0232
0.7500	-0.0241	0.0279	0.7500	-0.0254	0.0247
0.8000	-0.0237	0.0294	0.8000	-0.0252	0.0261
0.8500	-0.0232	0.0312	0.8500	-0.0249	0.0273
0.9000	-0.0225	0.0330	0.9000	-0.0245	0.0284
0.9500	-0.0213	0.0349	0.9500	-0.0234	0.0302
1.0000	-0.0195	0.0369	1.0000	-0.0213	0.0327
1.0500	-0.0173	0.0417	1.0500	-0.0183	0.0338
1.1000	-0.0153	0.0420	1.1000	-0.0162	0.0378
1.1500	-0.0140	0.0428	1.1500	-0.0165	0.0387
1.2000	-0.0125	0.0427	1.2000	-0.0160	0.0393
1.2500	-0.0107	0.0425	1.2500	-0.0140	0.0392
1.3000	-0.0090	0.0417	1.3000	-0.0116	0.0384
1.3500	-0.0075	0.0396	1.3500	-0.0097	0.0364
1.4000	-0.0062	0.0362	1.4000	-0.0083	0.0334
1.4500	-0.0050	0.0318	1.4500	-0.0079	0.0293
1.5000	-0.0038	0.0265	1.5000	-0.0054	0.0244
1.5500	-0.0025	0.0203	1.5500	-0.0036	0.0188
1.6000	-0.0011	0.0133	1.6000	-0.0016	0.0124
1.6411	0.0038	0.0038	1.6392	0.0037	0.0037

ROTOR 38 - Concluded

RAD = 9.9000 INCHES	RAD = 9.9560 INCHES
R_1 = 0.0041 INCHES	R_1 = 0.0040 INCHES
R_2 = 0.0036 INCHES	R_2 = 0.0035 INCHES
$L_{(SP)}$ = 0.8637 INCHES	$L_{(SP)}$ = 0.8668 INCHES
$H_{(SP)}$ = -0.0171 INCHES	$H_{(SP)}$ = -0.0205 INCHES
GAMMA = 64 DEG 58 MIN	GAMMA = 65 DEG 36 MIN

L	HP	HS	L	HP	HS
INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
0.0000	0.0041	0.0041	0.0000	0.0040	0.0040
0.0500	-0.0032	0.0088	0.0500	-0.0033	0.0083
0.1000	-0.0064	0.0095	0.1000	-0.0066	0.0085
0.1500	-0.0094	0.0101	0.1500	-0.0097	0.0088
0.2000	-0.0122	0.0108	0.2000	-0.0126	0.0091
0.2500	-0.0147	0.0115	0.2500	-0.0153	0.0094
0.3000	-0.0170	0.0122	0.3000	-0.0177	0.0098
0.3500	-0.0191	0.0129	0.3500	-0.0199	0.0103
0.4000	-0.0210	0.0137	0.4000	-0.0219	0.0107
0.4500	-0.0226	0.0145	0.4500	-0.0236	0.0113
0.5000	-0.0239	0.0154	0.5000	-0.0251	0.0119
0.5500	-0.0251	0.0164	0.5500	-0.0264	0.0126
0.6000	-0.0259	0.0174	0.6000	-0.0274	0.0134
0.6500	-0.0266	0.0184	0.6500	-0.0281	0.0143
0.7000	-0.0270	0.0196	0.7000	-0.0287	0.0153
0.7500	-0.0271	0.0208	0.7500	-0.0290	0.0163
0.8000	-0.0270	0.0222	0.8000	-0.0290	0.0176
0.8500	-0.0265	0.0237	0.8500	-0.0286	0.0191
0.9000	-0.0257	0.0254	0.9000	-0.0279	0.0209
0.9500	-0.0248	0.0273	0.9500	-0.0271	0.0228
1.0000	-0.0237	0.0292	1.0000	-0.0262	0.0246
1.0500	-0.0224	0.0315	1.0500	-0.0254	0.0264
1.1000	-0.0211	0.0333	1.1000	-0.0245	0.0278
1.1500	-0.0195	0.0344	1.1500	-0.0233	0.0289
1.2000	-0.0178	0.0355	1.2000	-0.0219	0.0299
1.2500	-0.0161	0.0356	1.2500	-0.0202	0.0302
1.3000	-0.0144	0.0347	1.3000	-0.0183	0.0298
1.3500	-0.0127	0.0328	1.3500	-0.0164	0.0283
1.4000	-0.0110	0.0301	1.4000	-0.0144	0.0260
1.4500	-0.0092	0.0265	1.4500	-0.0122	0.0229
1.5000	-0.0072	0.0221	1.5000	-0.0095	0.0191
1.5500	-0.0048	0.0170	1.5500	-0.0064	0.0148
1.6000	-0.0021	0.0113	1.6000	-0.0027	0.0102
1.6373	0.0036	0.0036	1.6350	0.0035	0.0035

BLADE MANUFACTURING COORDINATES FOR STATOR 38

RAD = 7.3590 INCHES

R_1 = 0.0045 INCHES
R_2 = 0.0045 INCHES

$L_{(SP)}$ = 0.5620 INCHES
$H_{(SP)}$ = 0.0806 INCHES
GAMMA = 27 DEG 12 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0045	0.0045
0.0500	0.0108	0.0282
0.1000	0.0218	0.0468
0.1500	0.0317	0.0635
0.2000	0.0407	0.0784
0.2500	0.0486	0.0914
0.3000	0.0555	0.1026
0.3500	0.0614	0.1122
0.4000	0.0663	0.1202
0.4500	0.0703	0.1263
0.5000	0.0730	0.1306
0.5500	0.0745	0.1328
0.6000	0.0747	0.1330
0.6500	0.0736	0.1310
0.7000	0.0712	0.1270
0.7500	0.0675	0.1209
0.8000	0.0624	0.1127
0.8500	0.0560	0.1022
0.9000	0.0481	0.0895
0.9500	0.0389	0.0745
1.0000	0.0283	0.0569
1.0500	0.0161	0.0369
1.1000	0.0025	0.0140
1.1137	0.0045	0.0045

RAD = 7.4930 INCHES

R_1 = 0.0045 INCHES
R_2 = 0.0045 INCHES

$L_{(SP)}$ = 0.5661 INCHES
$H_{(SP)}$ = 0.0814 INCHES
GAMMA = 26 DEG 39 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0045	0.0045
0.0500	0.0108	0.0285
0.1000	0.0218	0.0475
0.1500	0.0318	0.0644
0.2000	0.0407	0.0795
0.2500	0.0486	0.0927
0.3000	0.0555	0.1041
0.3500	0.0614	0.1138
0.4000	0.0662	0.1217
0.4500	0.0701	0.1279
0.5000	0.0728	0.1322
0.5500	0.0743	0.1345
0.6000	0.0745	0.1347
0.6500	0.0735	0.1329
0.7000	0.0712	0.1291
0.7500	0.0676	0.1231
0.8000	0.0627	0.1151
0.8500	0.0565	0.1048
0.9000	0.0489	0.0923
0.9500	0.0400	0.0776
1.0000	0.0297	0.0604
1.0500	0.0180	0.0406
1.1000	0.0049	0.0182
1.1223	0.0045	0.0045

RAD = 7.7000 INCHES

R_1 = 0.0046 INCHES
R_2 = 0.0045 INCHES

$L_{(SP)}$ = 0.5723 INCHES
$H_{(SP)}$ = 0.0822 INCHES
GAMMA = 25 DEG 52 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0046	0.0046
0.0500	0.0108	0.0290
0.1000	0.0218	0.0484
0.1500	0.0317	0.0657
0.2000	0.0406	0.0811
0.2500	0.0484	0.0945
0.3000	0.0552	0.1060
0.3500	0.0610	0.1158
0.4000	0.0657	0.1239
0.4500	0.0694	0.1300
0.5000	0.0721	0.1344
0.5500	0.0735	0.1368
0.6000	0.0737	0.1371
0.6500	0.0728	0.1355
0.7000	0.0706	0.1318
0.7500	0.0672	0.1261
0.8000	0.0626	0.1183
0.8500	0.0568	0.1084
0.9000	0.0497	0.0963
0.9500	0.0413	0.0819
1.0000	0.0316	0.0653
1.0500	0.0206	0.0461
1.1000	0.0082	0.0244
1.1355	0.0045	0.0045

STATOR 38 - Continued

RAD = 8.0000 INCHES

R_1 = 0.0046 INCHES

R_2 = 0.0046 INCHES

$L_{(SP)}$ = 0.5814 INCHES

$H_{(SP)}$ = 0.0833 INCHES

GAMMA = 24 DEG 53 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0046	0.0046
0.0500	0.0107	0.0297
0.1000	0.0216	0.0496
0.1500	0.0314	0.0673
0.2000	0.0401	0.0830
0.2500	0.0478	0.0967
0.3000	0.0545	0.1086
0.3500	0.0601	0.1185
0.4000	0.0647	0.1267
0.4500	0.0683	0.1330
0.5000	0.0708	0.1375
0.5500	0.0722	0.1400
0.6000	0.0724	0.1405
0.6500	0.0716	0.1391
0.7000	0.0696	0.1357
0.7500	0.0665	0.1303
0.8000	0.0623	0.1229
0.8500	0.0569	0.1134
0.9000	0.0504	0.1018
0.9500	0.0427	0.0881
1.0000	0.0338	0.0721
1.0500	0.0237	0.0538
1.1000	0.0124	0.0330
1.1500	0.0000	0.0096
1.1544	0.0046	0.0046

RAD = 8.2000 INCHES

R_1 = 0.0047 INCHES

R_2 = 0.0047 INCHES

$L_{(SP)}$ = 0.5874 INCHES

$H_{(SP)}$ = 0.0844 INCHES

GAMMA = 24 DEG 26 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0047	0.0047
0.0500	0.0106	0.0302
0.1000	0.0215	0.0504
0.1500	0.0313	0.0685
0.2000	0.0400	0.0845
0.2500	0.0476	0.0985
0.3000	0.0542	0.1105
0.3500	0.0598	0.1207
0.4000	0.0644	0.1290
0.4500	0.0679	0.1355
0.5000	0.0704	0.1400
0.5500	0.0718	0.1427
0.6000	0.0722	0.1434
0.6500	0.0714	0.1422
0.7000	0.0696	0.1389
0.7500	0.0666	0.1338
0.8000	0.0626	0.1266
0.8500	0.0575	0.1174
0.9000	0.0513	0.1061
0.9500	0.0439	0.0927
1.0000	0.0354	0.0770
1.0500	0.0258	0.0591
1.1000	0.0150	0.0387
1.1500	0.0030	0.0159
1.1669	0.0047	0.0047

RAD = 8.4000 INCHES

R_1 = 0.0047 INCHES

R_2 = 0.0047 INCHES

$L_{(SP)}$ = 0.5934 INCHES

$H_{(SP)}$ = 0.0860 INCHES

GAMMA = 24 DEG 5 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0047	0.0047
0.0500	0.0106	0.0307
0.1000	0.0215	0.0514
0.1500	0.0313	0.0699
0.2000	0.0400	0.0863
0.2500	0.0477	0.1006
0.3000	0.0543	0.1129
0.3500	0.0599	0.1233
0.4000	0.0645	0.1318
0.4500	0.0680	0.1385
0.5000	0.0705	0.1432
0.5500	0.0720	0.1460
0.6000	0.0724	0.1469
0.6500	0.0718	0.1459
0.7000	0.0701	0.1429
0.7500	0.0673	0.1379
0.8000	0.0635	0.1309
0.8500	0.0586	0.1219
0.9000	0.0526	0.1109
0.9500	0.0455	0.0977
1.0000	0.0373	0.0823
1.0500	0.0280	0.0647
1.1000	0.0176	0.0446
1.1500	0.0060	0.0221
1.1795	0.0047	0.0047

STATOR 38 - Continued

RAD = 9.0000 INCHES

R_1 = 0.0049 INCHES

R_2 = 0.0049 INCHES

$L_{(SP)}$ = 0.6108 INCHES

$H_{(SP)}$ = 0.0905 INCHES

GAMMA = 23 DEG 14 MIN

RAD = 9.2000 INCHES

R_1 = 0.0049 INCHES

R_2 = 0.0049 INCHES

$L_{(SP)}$ = 0.6164 INCHES

$H_{(SP)}$ = 0.0929 INCHES

GAMMA = 23 DEG 8 MIN

L INCHES	HP INCHES	HS INCHES	L INCHES	HP INCHES	HS INCHES
0.0000	0.0049	0.0049	0.0000	0.0049	0.0049
0.0500	0.0104	0.0322	0.0500	0.0104	0.0329
0.1000	0.0211	0.0542	0.1000	0.0212	0.0555
0.1500	0.0307	0.0737	0.1500	0.0309	0.0756
0.2000	0.0393	0.0911	0.2000	0.0396	0.0934
0.2500	0.0470	0.1063	0.2500	0.0473	0.1091
0.3000	0.0536	0.1195	0.3000	0.0540	0.1226
0.3500	0.0592	0.1306	0.3500	0.0598	0.1341
0.4000	0.0639	0.1398	0.4000	0.0645	0.1435
0.4500	0.0676	0.1471	0.4500	0.0683	0.1510
0.5000	0.0703	0.1524	0.5000	0.0711	0.1566
0.5500	0.0720	0.1558	0.5500	0.0729	0.1602
0.6000	0.0727	0.1573	0.6000	0.0737	0.1619
0.6500	0.0724	0.1569	0.6500	0.0736	0.1617
0.7000	0.0711	0.1545	0.7000	0.0724	0.1595
0.7500	0.0689	0.1502	0.7500	0.0703	0.1553
0.8000	0.0656	0.1439	0.8000	0.0672	0.1492
0.8500	0.0613	0.1356	0.8500	0.0630	0.1411
0.9000	0.0561	0.1252	0.9000	0.0579	0.1309
0.9500	0.0498	0.1128	0.9500	0.0518	0.1186
1.0000	0.0425	0.0982	1.0000	0.0446	0.1042
1.0500	0.0341	0.0814	1.0500	0.0365	0.0876
1.1000	0.0247	0.0623	1.1000	0.0273	0.0686
1.1500	0.0143	0.0408	1.1500	0.0171	0.0472
1.2000	0.0028	0.0166	1.2000	0.0058	0.0233
1.2170	0.0049	0.0049	1.2294	0.0049	0.0049

STATOR 38 - Concluded

RAD = 9.5030 INCHES

R_1 = 0.0050 INCHES

R_2 = 0.0050 INCHES

$L_{(SP)}$ = 0.6248 INCHES

$H_{(SP)}$ = 0.0967 INCHES

GAMMA = 23 DEG 9 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0050	0.0050
0.0500	0.0105	0.0341
0.1000	0.0214	0.0576
0.1500	0.0313	0.0786
0.2000	0.0402	0.0972
0.2500	0.0480	0.1135
0.3000	0.0549	0.1276
0.3500	0.0608	0.1396
0.4000	0.0657	0.1495
0.4500	0.0697	0.1574
0.5000	0.0726	0.1633
0.5500	0.0746	0.1673
0.6000	0.0756	0.1693
0.6500	0.0757	0.1693
0.7000	0.0747	0.1674
0.7500	0.0728	0.1636
0.8000	0.0699	0.1577
0.8500	0.0660	0.1499
0.9000	0.0611	0.1400
0.9500	0.0552	0.1280
1.0000	0.0483	0.1138
1.0500	0.0404	0.0974
1.1000	0.0314	0.0787
1.1500	0.0214	0.0575
1.2000	0.0104	0.0337
1.2486	0.0050	0.0050

RAD = 9.6060 INCHES

R_1 = 0.0050 INCHES

R_2 = 0.0051 INCHES

$L_{(SP)}$ = 0.6277 INCHES

$H_{(SP)}$ = 0.0991 INCHES

GAMMA = 23 DEG 20 MIN

L INCHES	HP INCHES	HS INCHES
0.0000	0.0050	0.0050
0.0500	0.0108	0.0347
0.1000	0.0219	0.0588
0.1500	0.0320	0.0802
0.2000	0.0411	0.0992
0.2500	0.0491	0.1159
0.3000	0.0562	0.1304
0.3500	0.0622	0.1426
0.4000	0.0673	0.1527
0.4500	0.0713	0.1608
0.5000	0.0744	0.1669
0.5500	0.0765	0.1710
0.6000	0.0776	0.1731
0.6500	0.0777	0.1732
0.7000	0.0768	0.1714
0.7500	0.0749	0.1677
0.8000	0.0720	0.1619
0.8500	0.0682	0.1541
0.9000	0.0633	0.1442
0.9500	0.0574	0.1323
1.0000	0.0505	0.1181
1.0500	0.0425	0.1017
1.1000	0.0335	0.0829
1.1500	0.0234	0.0616
1.2000	0.0122	0.0377
1.2500	0.0000	0.0110
1.2553	0.0051	0.0051

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TABLE I. - DESIGN OVERALL PERFORMANCE PARAMETERS FOR STAGES 35, 36, 37, AND 38

Parameters	Stage			
	35	36	37	38
ROTOR TOTAL PRESSURE RATIO	1.865	1.863	2.106	2.105
STAGE TOTAL PRESSURE RATIO	1.820	1.820	2.050	2.050
ROTOR TOTAL TEMPERATURE RATIO	1.225	1.227	1.270	1.269
STAGE TOTAL TEMPERATURE RATIO	1.225	1.227	1.270	1.269
ROTOR ADIABATIC EFFICIENCY	0.865	0.858	0.877	0.878
STAGE ADIABATIC EFFICIENCY	0.828	0.822	0.842	0.844
ROTOR POLYTROPIC EFFICIENCY	0.877	0.870	0.889	0.890
STAGE POLYTROPIC EFFICIENCY	0.842	0.837	0.857	0.859
ROTOR HEAD RISE COEFFICIENT	0.273	0.272	0.333	0.331
STAGE HEAD RISE COEFFICIENT	0.262	0.261	0.319	0.318
FLOW COEFFICIENT.	0.451	0.447	0.453	0.448
WT FLOW PER UNIT FRONTAL AREA	100.808	100.464	100.950	100.525
WT FLOW PER UNIT ANNULUS AREA	199.989	198.640	200.549	198.877
WT FLOW.	20.188	20.188	20.188	20.188
RPM	17188.700	17188.700	17185.700	17188.700
TIP SPEED	454.456	455.233	454.136	455.096
HUB-TIP RADIUS RATIO	0.70	0.70	0.70	0.70
ROTOR ASPECT RATIO	1.19	1.63	1.19	1.63
STATOR ASPECT RATIO	1.26	1.78	1.26	1.77
NUMBER OF ROTOR BLADES	36.0	48.0	36.0	48.0
NUMBER OF STATOR BLADES	46.0	62.0	46.0	62.0

TABLE II. - MECHANICAL DESIGN PARAMETERS

(a) Rotor

	Stage			
	35	36	37	38
Material	Maraging 200	Maraging 200	Maraging 200	Maraging 200
Yield strength, N/cm^2	142 720	142 720	142 720	142 720
Maximum stress, N/cm^2	51 848	46 306	60 604	49 998
Flutter parameter, bending	2.2	6.03	2.9	5.43
Flutter parameter, torsion	0.8	1.74	0.9	1.66
Number of blades	36	48	36	48
Design speed, rpm	17 188.7	17 188.7	17 188.7	17 188.7
Possible resonance rpm	15 000	11 000	13 000	12 000

(b) Stator

Material	Maraging 200	Maraging 200	Maraging 200	Maraging 200
Yield strength, N/cm^2	142 720	142 720	142 720	142 720
Maximum stress, N/cm^2	12 250	7101	15 168	10 480
Flutter parameter, bending	2.1	3.42	1.9	3.23
Flutter parameter, torsion	0.98	1.34	0.9	1.43
Number of blades	46	62	46	62
Possible resonance rpm	20 000	12 000	16 000	14 000

TABLE III. - OVERALL PERFORMANCE FOR STAGE 35

(a) 100 Percent of design speed

Parameters	Reading					
	4004	3978	3977	3974	3976	3975
ROTOR TOTAL PRESSURE RATIO	1.730	1.875	1.955	1.985	2.036	2.014
STATOR TOTAL PRESSURE RATIO	0.986	0.982	0.974	0.968	0.945	0.959
ROTOR TOTAL TEMPERATURE RATIO	1.190	1.226	1.245	1.254	1.277	1.263
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.001	1.000
ROTOR ADIABATIC EFFICIENCY	0.865	0.872	0.863	0.853	0.812	0.841
ROTOR MOMENTUM-RISE EFFICIENCY	0.861	0.869	0.859	0.853	0.808	0.836
ROTOR HEAD-RISE COEFFICIENT	0.286	0.341	0.371	[illegible]	0.402	0.391
FLOW COEFFICIENT	0.412	0.412	0.402	[illegible]	0.340	0.373
AIRFLOW PER UNIT FRONTAL AREA	101.42	100.77	99.15	[illegible]	88.08	94.57
AIRFLOW PER UNIT ANNULUS AREA	190.55	189.33	186.28	183.03	165.49	177.67
AIRFLOW AT ORIFICE	20.95	20.82	20.48	20.17	18.20	19.54
AIRFLOW AT ROTOR INLET	21.10	21.00	20.64	20.27	18.26	19.64
AIRFLOW AT ROTOR OUTLET	20.97	20.83	20.50	20.14	18.21	19.55
AIRFLOW AT STATOR OUTLET	20.08	19.92	19.49	19.11	16.98	18.41
ROTATIVE SPEED	17220.2	17119.1	17125.1	17196.8	17218.5	17224.5
PERCENT OF DESIGN SPEED	100.2	99.6	99.6	100.0	100.2	100.2
Compressor performance						
STAGE TOTAL PRESSURE RATIO	1.714	1.842	1.905	1.922	1.923	1.932
STAGE TOTAL TEMPERATURE RATIO	1.190	1.225	1.244	1.253	1.279	1.263
STAGE ADIABATIC EFFICIENCY	0.841	0.845	0.827	0.810	0.737	0.786

(b) 90 Percent of design speed

Parameters	Reading				
	3979	3982	3983	3984	3985
ROTOR TOTAL PRESSURE RATIO	1.591	1.680	1.729	1.740	1.781
STATOR TOTAL PRESSURE RATIO	0.989	0.988	0.982	0.979	0.965
ROTOR TOTAL TEMPERATURE RATIO	1.160	1.182	1.196	1.202	1.218
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.888	0.879	0.864	0.854	0.823
ROTOR MOMENTUM-RISE EFFICIENCY	0.886	0.877	0.863	0.852	0.821
ROTOR HEAD-RISE COEFFICIENT	0.286	0.327	0.351	0.360	0.378
FLOW COEFFICIENT	0.416	0.399	0.379	0.369	0.338
AIRFLOW PER UNIT FRONTAL AREA	94.39	91.83	88.31	86.24	80.39
AIRFLOW PER UNIT ANNULUS AREA	177.34	172.53	165.92	162.02	151.04
AIRFLOW AT ORIFICE	19.50	18.97	18.24	17.82	16.61
AIRFLOW AT ROTOR INLET	19.66	19.09	18.33	17.93	16.68
AIRFLOW AT ROTOR OUTLET	19.51	18.98	18.25	17.83	16.62
AIRFLOW AT STATOR OUTLET	18.60	18.08	17.24	16.81	15.45
ROTATIVE SPEED	15451.3	15477.7	15467.9	15473.4	15474.3
PERCENT OF DESIGN SPEED	89.9	90.0	90.0	90.0	90.0
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.574	1.660	1.698	1.711	1.719
STAGE TOTAL TEMPERATURE RATIO	1.160	1.182	1.196	1.202	1.218
STAGE ADIABATIC EFFICIENCY	0.865	0.858	0.835	0.820	0.768

TABLE III. - Continued.

(c) 80 Percent of design speed

Parameters	Reading 3987
ROTOR TOTAL PRESSURE RATIO	1.571
STATOR TOTAL PRESSURE RATIO	0.977
ROTOR TOTAL TEMPERATURE RATIO	1.168
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.818
ROTOR MOMENTUM-RISE EFFICIENCY	0.817
ROTOR HEAD-RISE COEFFICIENT	0.351
FLOW COEFFICIENT	0.322
AIRFLOW PER UNIT FRONTAL AREA	69.30
AIRFLOW PER UNIT ANNULUS AREA	130.19
AIRFLOW AT ORIFICE	14.32
AIRFLOW AT ROTOR INLET	14.48
AIRFLOW AT ROTOR OUTLET	14.32
AIRFLOW AT STATOR OUTLET	13.55
ROTATIVE SPEED	13774.4
PERCENT OF DESIGN SPEED	80.1
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.535
STAGE TOTAL TEMPERATURE RATIO	1.168
STAGE ADIABATIC EFFICIENCY	0.774

(d) 70 Percent of design speed

Parameters	Reading				
	3995	3994	3993	3990	3989
ROTOR TOTAL PRESSURE RATIO	1.264	1.300	1.343	1.356	1.375
STATOR TOTAL PRESSURE RATIO	0.989	0.993	0.993	0.992	0.982
ROTOR TOTAL TEMPERATURE RATIO	1.076	1.087	1.101	1.108	1.120
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.905	0.893	0.873	0.840	0.793
ROTOR MOMENTUM-RISE EFFICIENCY	0.899	0.895	0.871	0.842	0.794
ROTOR HEAD-RISE COEFFICIENT	0.212	0.240	0.275	0.288	0.306
FLOW COEFFICIENT	0.407	0.393	0.366	0.340	0.296
AIRFLOW PER UNIT FRONTAL AREA	76.53	74.11	69.63	64.93	57.06
AIRFLOW PER UNIT ANNULUS AREA	143.78	139.23	130.82	121.99	107.19
AIRFLOW AT ORIFICE	15.81	15.31	14.38	13.41	11.79
AIRFLOW AT ROTOR INLET	15.87	15.37	14.46	13.50	11.86
AIRFLOW AT ROTOR OUTLET	15.81	15.31	14.39	13.42	11.79
AIRFLOW AT STATOR OUTLET	15.12	14.60	13.74	12.78	11.15
ROTATIVE SPEED	12074.9	12074.5	12073.2	12040.8	12022.9
PERCENT OF DESIGN SPEED	70.2	70.2	70.2	70.1	69.9
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.250	1.291	1.334	1.345	1.350
STAGE TOTAL TEMPERATURE RATIO	1.077	1.087	1.101	1.108	1.120
STAGE ADIABATIC EFFICIENCY	0.860	0.868	0.852	0.816	0.744

TABLE III. - Concluded.

(e) 60 Percent of design speed

Parameters	Reading 3997
ROTOR TOTAL PRESSURE RATIO	1.275
STATOR TOTAL PRESSURE RATIO	0.989
ROTOR TOTAL TEMPERATURE RATIO	1.089
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.810
ROTOR MOMENTUM-RISE EFFICIENCY	0.810
ROTOR HEAD-RISE COEFFICIENT	0.297
FLOW COEFFICIENT	0.300
AIRFLOW PER UNIT FRONTAL AREA	50.81
AIRFLOW PER UNIT ANNULUS AREA	95.46
AIRFLOW AT ORIFICE	10.50
AIRFLOW AT ROTOR INLET	10.54
AIRFLOW AT ROTOR OUTLET	10.50
AIRFLOW AT STATOR OUTLET	9.99
ROTATIVE SPEED	10453.2
PERCENT OF DESIGN SPEED	60.8
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.262
STAGE TOTAL TEMPERATURE RATIO	1.089
STAGE ADIABATIC EFFICIENCY	0.771

(f) 50 Percent of design speed

Parameters	Reading 4000
ROTOR TOTAL PRESSURE RATIO	1.174
STATOR TOTAL PRESSURE RATIO	0.995
ROTOR TOTAL TEMPERATURE RATIO	1.057
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.820
ROTOR MOMENTUM-RISE EFFICIENCY	0.820
ROTOR HEAD-RISE COEFFICIENT	0.279
FLOW COEFFICIENT	0.307
AIRFLOW PER UNIT FRONTAL AREA	43.51
AIRFLOW PER UNIT ANNULUS AREA	81.75
AIRFLOW AT ORIFICE	8.99
AIRFLOW AT ROTOR INLET	8.96
AIRFLOW AT ROTOR OUTLET	8.99
AIRFLOW AT STATOR OUTLET	8.47
ROTATIVE SPEED	8582.4
PERCENT OF DESIGN SPEED	49.9
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.168
STAGE TOTAL TEMPERATURE RATIO	1.057
STAGE ADIABATIC EFFICIENCY	0.792

TABLE IV. - OVERALL PERFORMANCE FOR STAGE 36

(a) 100 Percent of design speed

Parameters	Reading				
	4273	4272	4271	4270	4269
ROTOR TOTAL PRESSURE RATIO	1.766	1.854	1.888	1.911	1.924
STATOR TOTAL PRESSURE RATIO	0.979	0.980	0.981	0.981	0.981
ROTOR TOTAL TEMPERATURE RATIO	1.207	1.227	1.235	1.241	1.245
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.852	0.850	0.848	0.844	0.841
ROTOR MOMENTUM-RISE EFFICIENCY	0.850	0.849	0.845	0.842	0.837
ROTOR HEAD-RISE COEFFICIENT	0.298	0.331	0.344	0.354	0.360
FLOW COEFFICIENT	0.404	0.400	0.396	0.391	0.386
AIRFLOW PER UNIT FRONTAL AREA	104.23	103.65	102.99	101.83	100.82
AIRFLOW PER UNIT ANNULUS AREA	206.09	204.95	203.63	201.33	199.35
AIRFLOW AT ORIFICE	20.94	20.83	20.69	20.46	20.26
AIRFLOW AT ROTOR INLET	20.78	20.64	20.48	20.23	20.03
AIRFLOW AT ROTOR OUTLET	20.96	20.84	20.71	20.47	20.27
AIRFLOW AT STATOR OUTLET	20.47	20.45	20.35	20.18	20.02
ROTATIVE SPEED	17191.5	17191.7	17187.6	17147.4	17140.5
PERCENT OF DESIGN SPEED	100.0	100.0	100.0	99.8	99.7
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.730	1.817	1.852	1.874	1.887
STAGE TOTAL TEMPERATURE RATIO	1.207	1.227	1.235	1.240	1.244
STAGE ADIABATIC EFFICIENCY	0.818	0.821	0.821	0.818	0.815

(b) 90 Percent of design speed

Parameters	Reading					
	4281	4280	4279	4282	4284	4277
ROTOR TOTAL PRESSURE RATIO	1.609	1.655	1.670	1.689	1.697	1.705
STATOR TOTAL PRESSURE RATIO	0.988	0.987	0.988	0.989	0.989	0.988
ROTOR TOTAL TEMPERATURE RATIO	1.163	1.174	1.179	1.185	1.189	1.192
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.892	0.890	0.884	0.873	0.862	0.857
ROTOR MOMENTUM-RISE EFFICIENCY	0.892	0.889	0.883	0.872	0.859	0.855
ROTOR HEAD-RISE COEFFICIENT	0.292	0.313	0.322	0.329	0.336	0.340
FLOW COEFFICIENT	0.412	0.406	0.399	0.391	0.381	0.376
AIRFLOW PER UNIT FRONTAL AREA	98.27	97.11	95.81	94.55	92.55	91.50
AIRFLOW PER UNIT ANNULUS AREA	194.30	192.02	189.44	186.94	183.00	180.92
AIRFLOW AT ORIFICE	19.75	19.51	19.25	19.00	18.68	18.39
AIRFLOW AT ROTOR INLET	19.54	19.32	19.02	18.79	18.34	18.16
AIRFLOW AT ROTOR OUTLET	19.75	19.52	19.26	19.01	18.61	18.40
AIRFLOW AT STATOR OUTLET	19.29	19.08	18.83	18.58	18.13	17.95
ROTATIVE SPEED	15481.5	15471.1	15437.3	15489.0	15440.6	15448.6
PERCENT OF DESIGN SPEED	90.1	90.0	89.8	90.1	89.8	89.9
Compressor performance						
STAGE TOTAL PRESSURE RATIO	1.590	1.634	1.651	1.670	1.679	1.685
STAGE TOTAL TEMPERATURE RATIO	1.163	1.174	1.178	1.185	1.189	1.192
STAGE ADIABATIC EFFICIENCY	0.867	0.867	0.863	0.854	0.844	0.838

TABLE IV. - Continued.

(c) 80 Percent of design speed

Parameters	Reading 4294
ROTOR TOTAL PRESSURE RATIO	1.522
STATOR TOTAL PRESSURE RATIO	0.991
ROTOR TOTAL TEMPERATURE RATIO	1.148
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.864
ROTOR MOMENTUM-RISE EFFICIENCY	0.863
ROTOR HEAD-RISE COEFFICIENT	0.320
FLOW COEFFICIENT	0.359
AIRFLOW PER UNIT FRONTAL AREA	80.13
AIRFLOW PER UNIT ANNULUS AREA	158.45
AIRFLOW AT ORIFICE	16.10
AIRFLOW AT ROTOR INLET	15.87
AIRFLOW AT ROTOR OUTLET	16.11
AIRFLOW AT STATOR OUTLET	15.67
ROTATIVE SPEED	13737.4
PERCENT OF DESIGN SPEED	79.9
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.509
STAGE TOTAL TEMPERATURE RATIO	1.147
STAGE ADIABATIC EFFICIENCY	0.846

(d) 70 Percent of design speed

Parameters	Reading				
	4301	4299	4298	4297	4296
ROTOR TOTAL PRESSURE RATIO	1.267	1.302	1.331	1.365	1.375
STATOR TOTAL PRESSURE RATIO	0.985	0.991	0.993	0.993	0.992
ROTOR TOTAL TEMPERATURE RATIO	1.077	1.086	1.095	1.108	1.114
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.912	0.909	0.893	0.860	0.836
ROTOR MOMENTUM-RISE EFFICIENCY	0.915	0.904	0.904	0.864	0.840
ROTOR HEAD-RISE COEFFICIENT	0.215	0.243	0.266	0.294	0.302
FLOW COEFFICIENT	0.411	0.396	0.379	0.350	0.333
AIRFLOW PER UNIT FRONTAL AREA	80.13	77.65	74.87	69.78	66.88
AIRFLOW PER UNIT ANNULUS AREA	158.43	153.52	148.03	137.97	132.24
AIRFLOW AT ORIFICE	16.10	15.60	15.04	14.02	13.44
AIRFLOW AT ROTOR INLET	15.92	15.44	14.85	13.84	13.24
AIRFLOW AT ROTOR OUTLET	16.10	15.60	15.05	14.03	13.44
AIRFLOW AT STATOR OUTLET	15.85	15.34	14.71	13.66	13.06
ROTATIVE SPEED	12019.0	12026.1	12016.0	12019.0	12030.0
PERCENT OF DESIGN SPEED	69.9	70.0	69.9	69.9	70.0
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.247	1.290	1.322	1.355	1.364
STAGE TOTAL TEMPERATURE RATIO	1.077	1.086	1.095	1.108	1.114
STAGE ADIABATIC EFFICIENCY	0.848	0.875	0.871	0.840	0.815

TABLE IV. - Concluded.

(e) 60 Percent of design speed

Parameters	Reading 4304
ROTOR TOTAL PRESSURE RATIO	1.261
STATOR TOTAL PRESSURE RATIO	0.993
ROTOR TOTAL TEMPERATURE RATIO	1.083
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.825
ROTOR MOMENTUM-RISE EFFICIENCY	0.826
ROTOR HEAD-RISE COEFFICIENT	0.290
FLOW COEFFICIENT	0.308
AIRFLOW PER UNIT FRONTAL AREA	53.93
AIRFLOW PER UNIT ANNULUS AREA	106.64
AIRFLOW AT ORIFICE	10.84
AIRFLOW AT ROTOR INLET	10.67
AIRFLOW AT ROTOR OUTLET	10.84
AIRFLOW AT STATOR OUTLET	10.53
ROTATIVE SPEED	10293.3
PERCENT OF DESIGN SPEED	59.9
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.253
STAGE TOTAL TEMPERATURE RATIO	1.083
STAGE ADIABATIC EFFICIENCY	0.801

(f) 50 Percent of design speed

Parameters	Reading 4309
ROTOR TOTAL PRESSURE RATIO	1.175
STATOR TOTAL PRESSURE RATIO	0.996
ROTOR TOTAL TEMPERATURE RATIO	1.058
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.817
ROTOR MOMENTUM-RISE EFFICIENCY	0.823
ROTOR HEAD-RISE COEFFICIENT	0.277
FLOW COEFFICIENT	0.300
AIRFLOW PER UNIT FRONTAL AREA	44.95
AIRFLOW PER UNIT ANNULUS AREA	88.88
AIRFLOW AT ORIFICE	9.03
AIRFLOW AT ROTOR INLET	8.78
AIRFLOW AT ROTOR OUTLET	9.03
AIRFLOW AT STATOR OUTLET	8.61
ROTATIVE SPEED	8624.9
PERCENT OF DESIGN SPEED	50.2
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.170
STAGE TOTAL TEMPERATURE RATIO	1.058
STAGE ADIABATIC EFFICIENCY	0.794

TABLE V. - OVERALL PERFORMANCE FOR STAGE 37

(a) 100 Percent of design speed

Parameters	Reading				
	4193	4192	4182	4188	4187
ROTOR TOTAL PRESSURE RATIO	1.785	1.917	2.056	2.157	2.196
STATOR TOTAL PRESSURE RATIO	0.983	0.980	0.973	0.963	0.953
ROTOR TOTAL TEMPERATURE RATIO	1.214	1.237	1.261	1.283	1.296
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.842	0.862	0.876	0.867	0.852
ROTOR MOMENTUM-RISE EFFICIENCY	0.840	0.859	0.867	0.863	0.848
ROTOR HEAD-RISE COEFFICIENT	0.306	0.356	0.402	0.440	0.458
FLOW COEFFICIENT	0.406	0.405	0.401	0.393	0.373
AIRFLOW PER UNIT FRONTAL AREA	104.68	104.15	103.73	102.15	98.03
AIRFLOW PER UNIT ANNULUS AREA	207.95	206.90	206.06	202.94	194.74
AIRFLOW AT ORIFICE	20.93	20.83	20.74	20.43	19.60
AIRFLOW AT ROTOR INLET	20.82	20.75	20.70	20.36	[illegible]
AIRFLOW AT ROTOR OUTLET	20.95	20.84	20.76	20.45	19.62
AIRFLOW AT STATOR OUTLET	19.91	19.78	19.89	19.10	18.11
ROTATIVE SPEED	17196.8	17169.3	17254.8	17229.7	17203.6
PERCENT OF DESIGN SPEED	100.0	99.9	100.4	100.2	100.1
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.753	1.879	2.000	2.070	2.093
STAGE TOTAL TEMPERATURE RATIO	1.214	1.237	1.261	1.283	1.296
STAGE ADIABATIC EFFICIENCY	0.814	0.834	0.840	0.821	0.793

(b) 90 Percent of design speed

Parameters	Reading				
	4209	4208	4207	4205	4204
ROTOR TOTAL PRESSURE RATIO	1.636	1.775	1.853	1.896	1.909
STATOR TOTAL PRESSURE RATIO	0.983	0.986	0.981	0.974	0.968
ROTOR TOTAL TEMPERATURE RATIO	1.170	1.194	1.213	1.228	1.236
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.889	0.916	0.904	0.879	0.860
ROTOR MOMENTUM-RISE EFFICIENCY	0.888	0.916	0.905	0.878	0.858
ROTOR HEAD-RISE COEFFICIENT	0.305	0.369	0.405	0.426	0.433
FLOW COEFFICIENT	0.416	0.413	0.395	0.369	0.353
AIRFLOW PER UNIT FRONTAL AREA	98.70	98.05	94.76	90.04	86.95
AIRFLOW PER UNIT ANNULUS AREA	196.07	194.79	188.26	178.87	172.73
AIRFLOW AT ORIFICE	19.74	19.61	18.95	18.01	17.39
AIRFLOW AT ROTOR INLET	19.67	19.53	18.89	17.91	17.26
AIRFLOW AT ROTOR OUTLET	19.75	19.62	18.96	18.02	17.40
AIRFLOW AT STATOR OUTLET	18.76	18.58	17.93	16.86	16.08
ROTATIVE SPEED	15484.7	15469.6	15468.0	15481.9	15492.8
PERCENT OF DESIGN SPEED	90.1	90.0	90.0	90.1	90.1
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.607	1.751	1.819	1.847	1.847
STAGE TOTAL TEMPERATURE RATIO	1.170	1.194	1.213	1.228	1.236
STAGE ADIABATIC EFFICIENCY	0.855	0.893	0.876	0.841	0.812

TABLE V. - Continued.

(c) 80 Percent of design speed

Parameters	Reading 4194
ROTOR TOTAL PRESSURE RATIO	1.653
STATOR TOTAL PRESSURE RATIO	0.984
ROTOR TOTAL TEMPERATURE RATIO	1.178
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.867
ROTOR MOMENTUM-RISE EFFICIENCY	0.864
ROTOR HEAD-RISE COEFFICIENT	0.399
FLOW COEFFICIENT	0.346
AIRFLOW PER UNIT FRONTAL AREA	76.98
AIRFLOW PER UNIT ANNULUS AREA	152.92
AIRFLOW AT ORIFICE	15.39
AIRFLOW AT ROTOR INLET	15.35
AIRFLOW AT ROTOR OUTLET	15.40
AIRFLOW AT STATOR OUTLET	14.49
ROTATIVE SPEED	13756.7
PERCENT OF DESIGN SPEED	80.0
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.626
STAGE TOTAL TEMPERATURE RATIO	1.178
STAGE ADIABATIC EFFICIENCY	0.838

(d) 70 Percent of design speed

Parameters	Reading					
	4202	4203	4201	4198	4196	4195
ROTOR TOTAL PRESSURE RATIO	1.308	1.345	1.382	1.407	1.431	1.442
STATOR TOTAL PRESSURE RATIO	0.973	0.987	0.992	0.994	0.993	0.989
ROTOR TOTAL TEMPERATURE RATIO	1.086	1.095	1.106	1.113	1.122	1.129
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.925	0.932	0.916	0.906	0.884	0.854
ROTOR MOMENTUM-RISE EFFICIENCY	0.927	0.933	0.919	0.905	0.883	0.854
ROTOR HEAD-RISE COEFFICIENT	0.248	0.278	0.307	0.327	0.346	0.356
FLOW COEFFICIENT	0.410	0.410	0.394	0.370	0.350	0.333
AIRFLOW PER UNIT FRONTAL AREA	81.26	79.68	77.22	74.55	70.98	66.52
AIRFLOW PER UNIT ANNULUS AREA	161.44	158.29	153.41	148.10	141.02	132.14
AIRFLOW AT ORIFICE	16.25	15.93	15.44	14.91	14.19	13.30
AIRFLOW AT ROTOR INLET	16.17	15.86	15.30	14.81	14.11	13.24
AIRFLOW AT ROTOR OUTLET	16.25	15.94	15.45	14.91	14.20	13.31
AIRFLOW AT STATOR OUTLET	15.45	15.11	14.60	14.05	13.30	12.54
ROTATIVE SPEED	12046.2	12016.4	12044.7	12018.3	12036.1	12038.9
PERCENT OF DESIGN SPEED	70.1	69.9	70.1	69.9	70.0	70.0
Compressor performance						
STAGE TOTAL PRESSURE RATIO	1.273	1.327	1.372	1.398	1.420	1.427
STAGE TOTAL TEMPERATURE RATIO	1.086	1.095	1.106	1.113	1.122	1.129
STAGE ADIABATIC EFFICIENCY	0.826	0.886	0.893	0.889	0.866	0.829

TABLE V. - Concluded.

(e) 60 Percent of design speed

Parameters	Reading 4215
ROTOR TOTAL PRESSURE RATIO	1.305
STATOR TOTAL PRESSURE RATIO	0.992
ROTOR TOTAL TEMPERATURE RATIO	1.093
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.848
ROTOR MOMENTUM-RISE EFFICIENCY	0.847
ROTOR HEAD-RISE COEFFICIENT	0.337
FLOW COEFFICIENT	0.318
AIRFLOW PER UNIT FRONTAL AREA	55.26
AIRFLOW PER UNIT ANNULUS AREA	109.78
AIRFLOW AT ORIFICE	11.05
AIRFLOW AT ROTOR INLET	10.99
AIRFLOW AT ROTOR OUTLET	11.05
AIRFLOW AT STATOR OUTLET	10.39
ROTATIVE SPEED	10307.0
PERCENT OF DESIGN SPEED	60.0
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.295
STAGE TOTAL TEMPERATURE RATIO	1.093
STAGE ADIABATIC EFFICIENCY	0.822

(f) 50 Percent of design speed

Parameters	Reading 4218
ROTOR TOTAL PRESSURE RATIO	1.202
STATOR TOTAL PRESSURE RATIO	0.995
ROTOR TOTAL TEMPERATURE RATIO	1.064
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.848
ROTOR MOMENTUM-RISE EFFICIENCY	0.848
ROTOR HEAD-RISE COEFFICIENT	0.323
FLOW COEFFICIENT	0.314
AIRFLOW PER UNIT FRONTAL AREA	45.90
AIRFLOW PER UNIT ANNULUS AREA	91.18
AIRFLOW AT ORIFICE	9.18
AIRFLOW AT ROTOR INLET	9.13
AIRFLOW AT ROTOR OUTLET	9.18
AIRFLOW AT STATOR OUTLET	8.61
ROTATIVE SPEED	8592.5
PERCENT OF DESIGN SPEED	50.0
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.197
STAGE TOTAL TEMPERATURE RATIO	1.064
STAGE ADIABATIC EFFICIENCY	0.826

TABLE VI. - OVERALL PERFORMANCE FOR STAGE 38

(a) 100 Percent of design speed

Parameters	Reading					
	4129	4128	4123	4121	4120	4119
ROTOR TOTAL PRESSURE RATIO	1.799	1.846	1.858	1.912	1.969	2.004
STATOR TOTAL PRESSURE RATIO	0.980	0.984	0.985	0.986	0.987	0.987
ROTOR TOTAL TEMPERATURE RATIO	1.217	1.226	1.228	1.240	1.252	1.259
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.842	0.847	0.847	0.848	0.849	0.848
ROTOR MOMENTUM-RISE EFFICIENCY	0.839	0.844	0.845	0.846	0.845	0.847
ROTOR HEAD-RISE COEFFICIENT	0.310	0.327	0.333	0.351	0.372	0.386
FLOW COEFFICIENT	0.409	0.408	0.407	0.405	0.400	0.394
AIRFLOW PER UNIT FRONTAL AREA	104.41	104.13	104.11	103.75	102.91	101.80
AIRFLOW PER UNIT ANNULUS AREA	206.57	206.00	205.96	205.25	203.60	201.40
AIRFLOW AT ORIFICE	20.97	20.91	20.91	20.83	20.67	20.44
AIRFLOW AT ROTOR INLET	20.97	20.93	20.89	20.83	20.65	20.43
AIRFLOW AT ROTOR OUTLET	20.98	20.92	20.92	20.85	20.68	20.46
AIRFLOW AT STATOR OUTLET	21.10	21.01	20.94	20.91	20.81	20.64
ROTATIVE SPEED	17223.9	17226.8	17185.7	17221.7	17227.9	17205.9
PERCENT OF DESIGN SPEED	100.2	100.2	100.0	100.2	100.2	100.1
Compressor performance						
STAGE TOTAL PRESSURE RATIO	1.763	1.816	1.829	1.885	1.944	1.977
STAGE TOTAL TEMPERATURE RATIO	1.218	1.226	1.229	1.240	1.252	1.259
STAGE ADIABATIC EFFICIENCY	0.809	0.821	0.823	0.827	0.831	0.831

(b) 90 Percent of design speed

Parameters	Reading				
	4140	4139	4133	4132	4131
ROTOR TOTAL PRESSURE RATIO	1.654	1.697	1.732	1.764	1.778
STATOR TOTAL PRESSURE RATIO	0.978	0.984	0.987	0.990	0.990
ROTOR TOTAL TEMPERATURE RATIO	1.173	1.182	1.189	1.197	1.201
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.896	0.897	0.901	0.894	0.888
ROTOR MOMENTUM-RISE EFFICIENCY	0.894	0.896	0.899	0.893	0.887
ROTOR HEAD-RISE COEFFICIENT	0.313	0.331	0.350	0.362	0.370
FLOW COEFFICIENT	0.419	0.417	0.412	0.406	0.397
AIRFLOW PER UNIT FRONTAL AREA	98.41	98.41	97.28	96.41	94.73
AIRFLOW PER UNIT ANNULUS AREA	194.69	194.70	192.46	190.75	187.42
AIRFLOW AT ORIFICE	19.76	19.76	19.54	19.36	19.02
AIRFLOW AT ROTOR INLET	19.77	19.74	19.51	19.33	18.99
AIRFLOW AT ROTOR OUTLET	19.77	19.77	19.55	19.37	19.03
AIRFLOW AT STATOR OUTLET	19.71	19.60	19.44	19.28	18.81
ROTATIVE SPEED	15462.1	15516.3	15447.0	15507.9	15478.7
PERCENT OF DESIGN SPEED	90.0	90.3	89.9	90.2	90.1
Compressor performance					
STAGE TOTAL PRESSURE RATIO	1.617	1.670	1.710	1.746	1.761
STAGE TOTAL TEMPERATURE RATIO	1.173	1.182	1.189	1.197	1.201
STAGE ADIABATIC EFFICIENCY	0.851	0.867	0.877	0.877	0.872

TABLE VI. - Continued.

(c) 80 Percent of design speed

Parameters	Reading 4093
ROTOR TOTAL PRESSURE RATIO	1.577
STATOR TOTAL PRESSURE RATIO	0.991
ROTOR TOTAL TEMPERATURE RATIO	1.154
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.905
ROTOR MOMENTUM-RISE EFFICIENCY	0.901
ROTOR HEAD-RISE COEFFICIENT	0.351
FLOW COEFFICIENT	0.384
AIRFLOW PER UNIT FRONTAL AREA	83.47
AIRFLOW PER UNIT ANNULUS AREA	165.13
AIRFLOW AT ORIFICE	16.76
AIRFLOW AT ROTOR INLET	16.79
AIRFLOW AT ROTOR OUTLET	16.77
AIRFLOW AT STATOR OUTLET	16.55
ROTATIVE SPEED	13735.9
PERCENT OF DESIGN SPEED	79.9
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.563
STAGE TOTAL TEMPERATURE RATIO	1.153
STAGE ADIABATIC EFFICIENCY	0.887

(d) 70 Percent of design speed

Parameters	Reading					
	4097	4098	4099	4100	4101	4095
ROTOR TOTAL PRESSURE RATIO	1.333	1.360	1.381	1.396	1.410	1.420
STATOR TOTAL PRESSURE RATIO	0.974	0.986	0.990	0.992	0.993	0.993
ROTOR TOTAL TEMPERATURE RATIO	1.090	1.098	1.104	1.109	1.114	1.120
STATOR TOTAL TEMPERATURE RATIO	1.000	1.000	1.000	1.000	1.000	1.000
ROTOR ADIABATIC EFFICIENCY	0.949	0.937	0.926	0.915	0.903	0.876
ROTOR MOMENTUM-RISE EFFICIENCY	0.951	0.935	0.927	0.914	0.903	0.874
ROTOR HEAD-RISE COEFFICIENT	0.267	0.289	0.306	0.318	0.329	0.338
FLOW COEFFICIENT	0.416	0.404	0.391	0.381	0.368	0.350
AIRFLOW PER UNIT FRONTAL AREA	80.39	78.14	76.02	74.29	72.21	68.95
AIRFLOW PER UNIT ANNULUS AREA	159.05	154.60	150.40	146.98	142.85	136.44
AIRFLOW AT ORIFICE	16.14	15.69	15.27	14.92	14.50	13.85
AIRFLOW AT ROTOR INLET	16.11	15.66	15.24	14.89	14.46	13.81
AIRFLOW AT ROTOR OUTLET	16.15	15.70	15.27	14.92	14.50	13.85
AIRFLOW AT STATOR OUTLET	16.12	15.55	15.08	14.71	14.27	13.59
ROTATIVE SPEED	12026.2	12003.6	11999.4	12002.6	12005.1	12014.2
PERCENT OF DESIGN SPEED	70.0	69.8	69.8	69.8	69.8	69.9
Compressor performance						
STAGE TOTAL PRESSURE RATIO	1.299	1.341	1.367	1.385	1.400	1.410
STAGE TOTAL TEMPERATURE RATIO	1.090	1.098	1.105	1.109	1.114	1.120
STAGE ADIABATIC EFFICIENCY	0.857	0.892	0.895	0.892	0.884	0.859

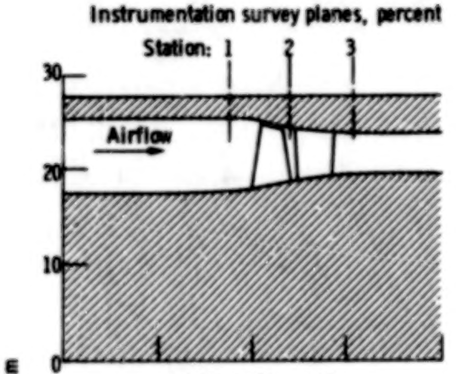
TABLE VI. - Concluded.

(e) 60 Percent of design speed

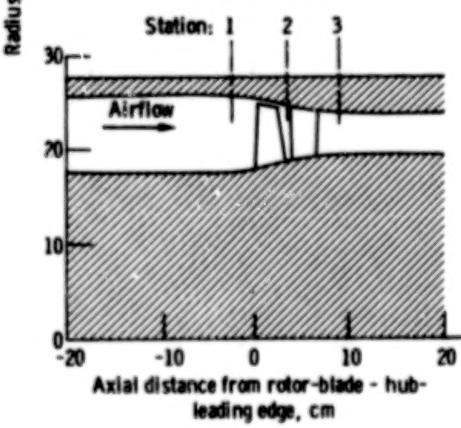
Parameters	Reading 4104
ROTOR TOTAL PRESSURE RATIO	1.312
STATOR TOTAL PRESSURE RATIO	0.994
ROTOR TOTAL TEMPERATURE RATIO	1.093
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.870
ROTOR MOMENTUM-RISE EFFICIENCY	0.869
ROTOR HEAD-RISE COEFFICIENT	0.322
FLOW COEFFICIENT	0.328
AIRFLOW PER UNIT FRONTAL AREA	58.49
AIRFLOW PER UNIT ANNULUS AREA	115.71
AIRFLOW AT ORIFICE	11.75
AIRFLOW AT ROTOR INLET	11.66
AIRFLOW AT ROTOR OUTLET	11.75
AIRFLOW AT STATOR OUTLET	11.60
ROTATIVE SPEED	10621.2
PERCENT OF DESIGN SPEED	61.8
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.304
STAGE TOTAL TEMPERATURE RATIO	1.093
STAGE ADIABATIC EFFICIENCY	0.851

(f) 50 Percent of design speed

Parameters	Reading 4102
ROTOR TOTAL PRESSURE RATIO	1.194
STATOR TOTAL PRESSURE RATIO	0.996
ROTOR TOTAL TEMPERATURE RATIO	1.059
STATOR TOTAL TEMPERATURE RATIO	1.000
ROTOR ADIABATIC EFFICIENCY	0.878
ROTOR MOMENTUM-RISE EFFICIENCY	0.879
ROTOR HEAD-RISE COEFFICIENT	0.310
FLOW COEFFICIENT	0.317
AIRFLOW PER UNIT FRONTAL AREA	46.28
AIRFLOW PER UNIT ANNULUS AREA	91.55
AIRFLOW AT ORIFICE	9.29
AIRFLOW AT ROTOR INLET	9.21
AIRFLOW AT ROTOR OUTLET	9.29
AIRFLOW AT STATOR OUTLET	9.16
ROTATIVE SPEED	8562.7
PERCENT OF DESIGN SPEED	49.8
Compressor performance	
STAGE TOTAL PRESSURE RATIO	1.189
STAGE TOTAL TEMPERATURE RATIO	1.059
STAGE ADIABATIC EFFICIENCY	0.858


Instrumentation survey planes, percent
Station: 1
2
3
30
Airflow
20
10
0
Radius, cm

(a) Stages 35 and 37.

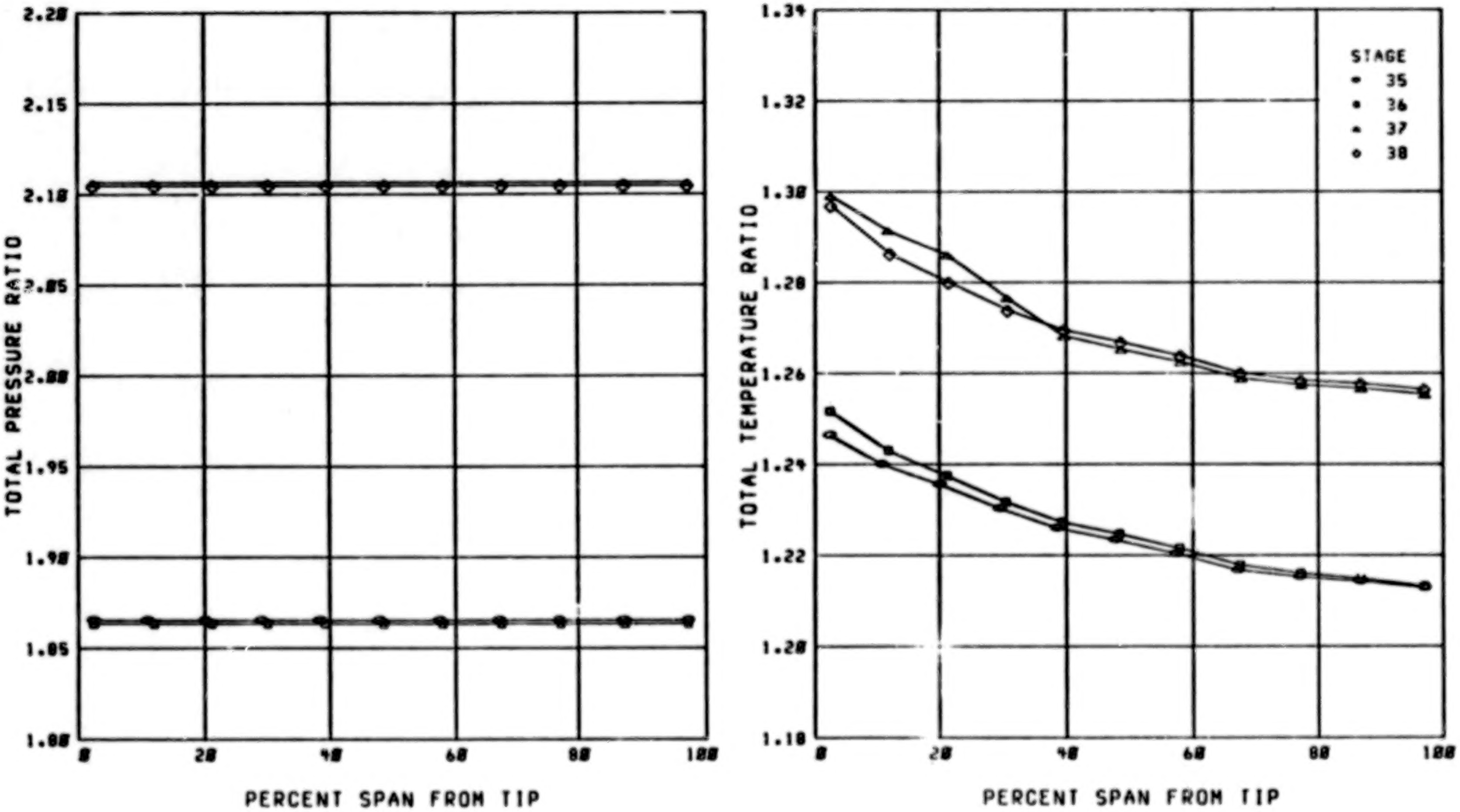

Station: 1
2
3
30
Airflow
20
10
0
-20
-10
0
10
20
Axial distance from rotor-blade - hub-leading edge, cm

(b) Stages 36 and 38.

Flow path coordinates

Inner		Outer	
Axial distance, cm	Radius, cm	Axial distance, cm	Radius, cm
-22.860	17.526	-22.860	25.654
-15.400	17.526	-15.400	25.654
-7.620	17.526	-7.620	25.654
-2.568	17.539	-2.568	25.643
0.000	17.780	0.00	25.400
1.854	18.255	.632	25.247
4.137	18.714	1.854	24.925
4.859	18.821	1.974	24.882
6.566	19.035	3.282	24.511
8.890	19.279	4.445	24.285
10.640	19.380	4.859	24.232
12.700	19.431	6.538	24.145
15.400	19.431	8.628	24.011
		8.890	23.993
		10.640	23.851
		12.700	23.749
		15.400	23.749

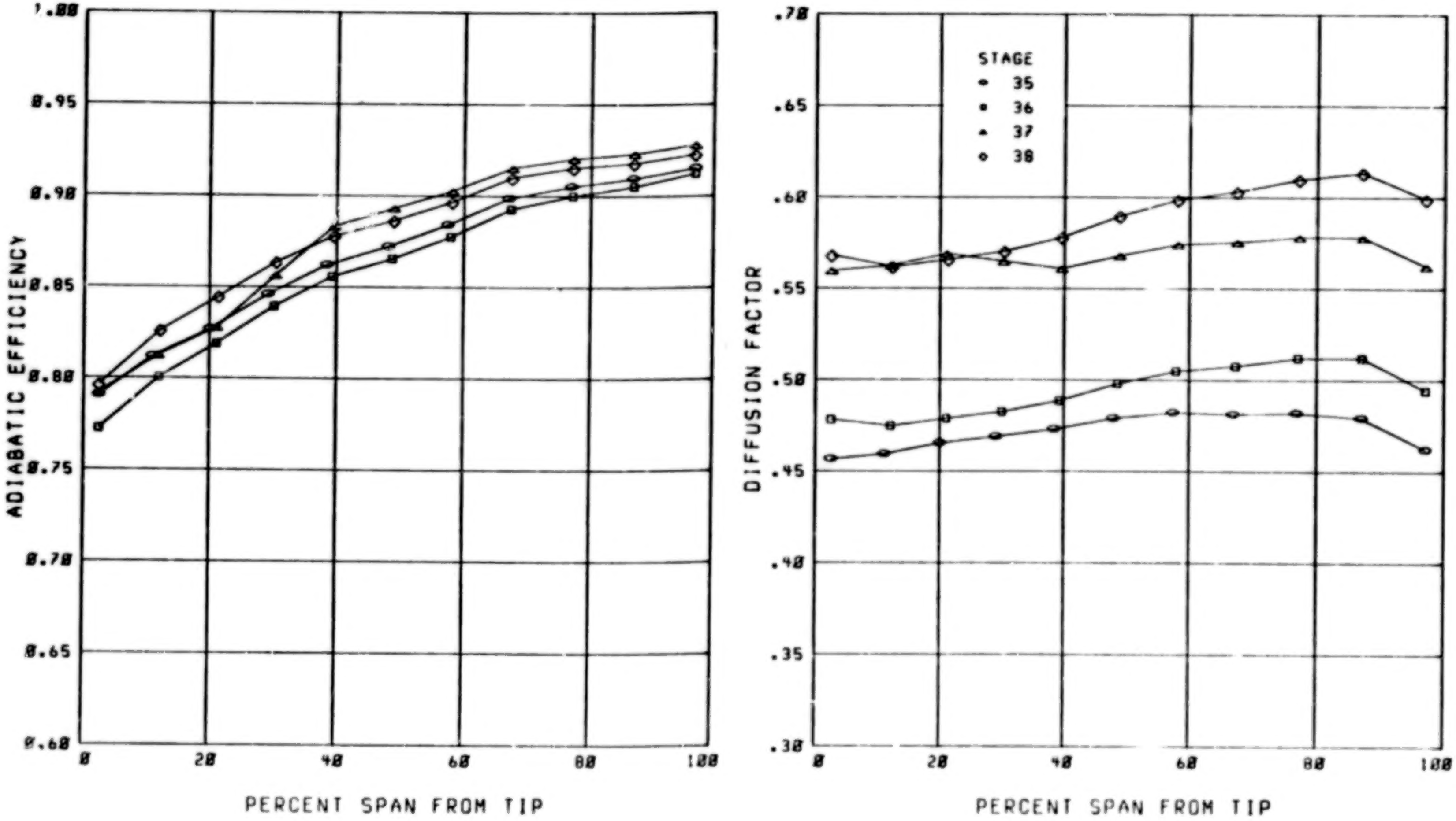
Figure 1. - Flow path and instrumentation stations.



(a) Total pressure ratio.

(b) Total temperature ratio.

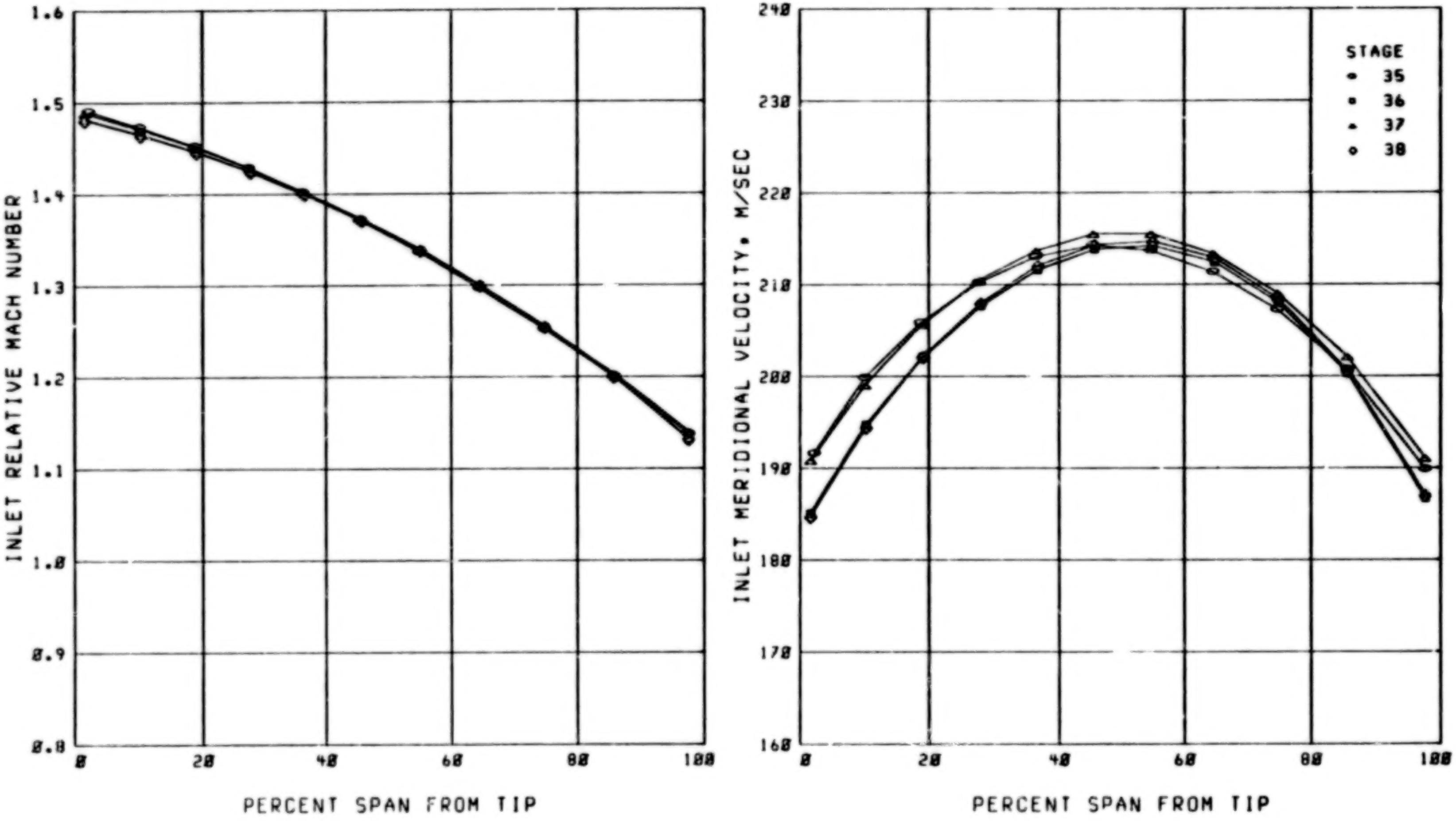
Figure 2. - Design radial distributions of rotor blade parameters.



(c) Adiabatic efficiency.

(d) Diffusion factor.

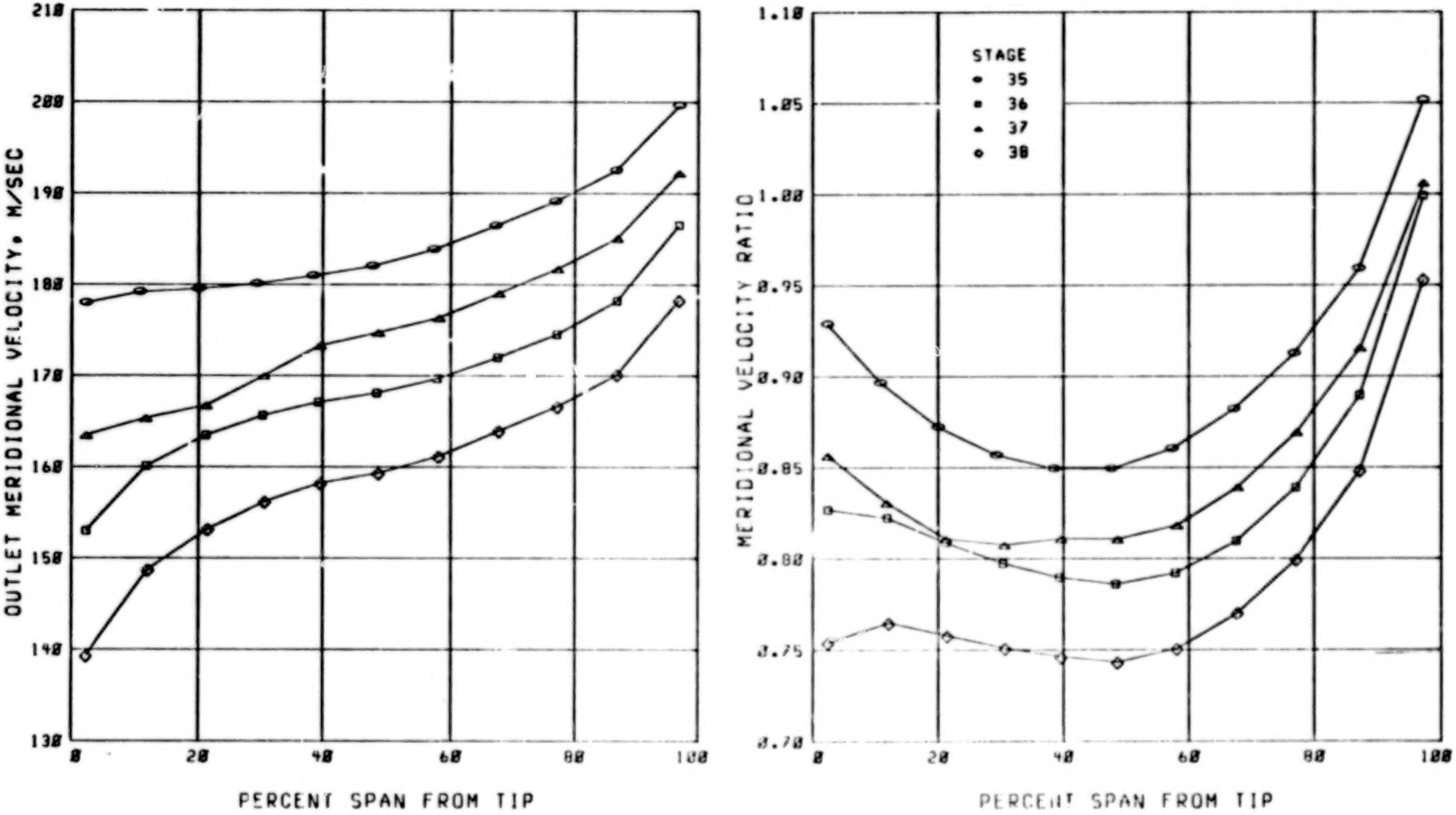
Figure 2. - Continued.



(e) Inlet relative Mach number.

(f) Inlet meridional velocity.

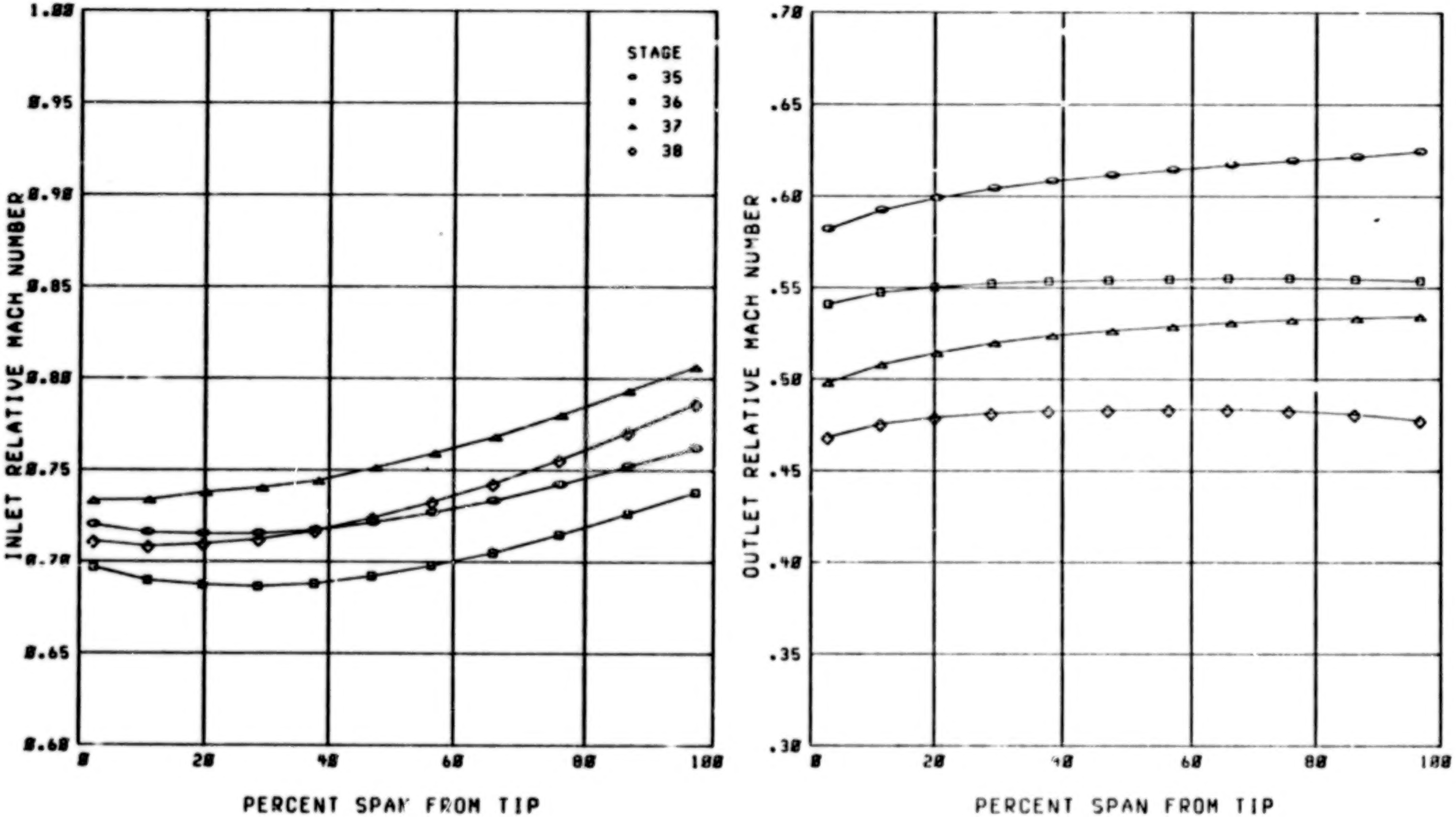
Figure 2. - Continued.



(g) Outlet meridional velocity.

(h) Meridional velocity ratio.

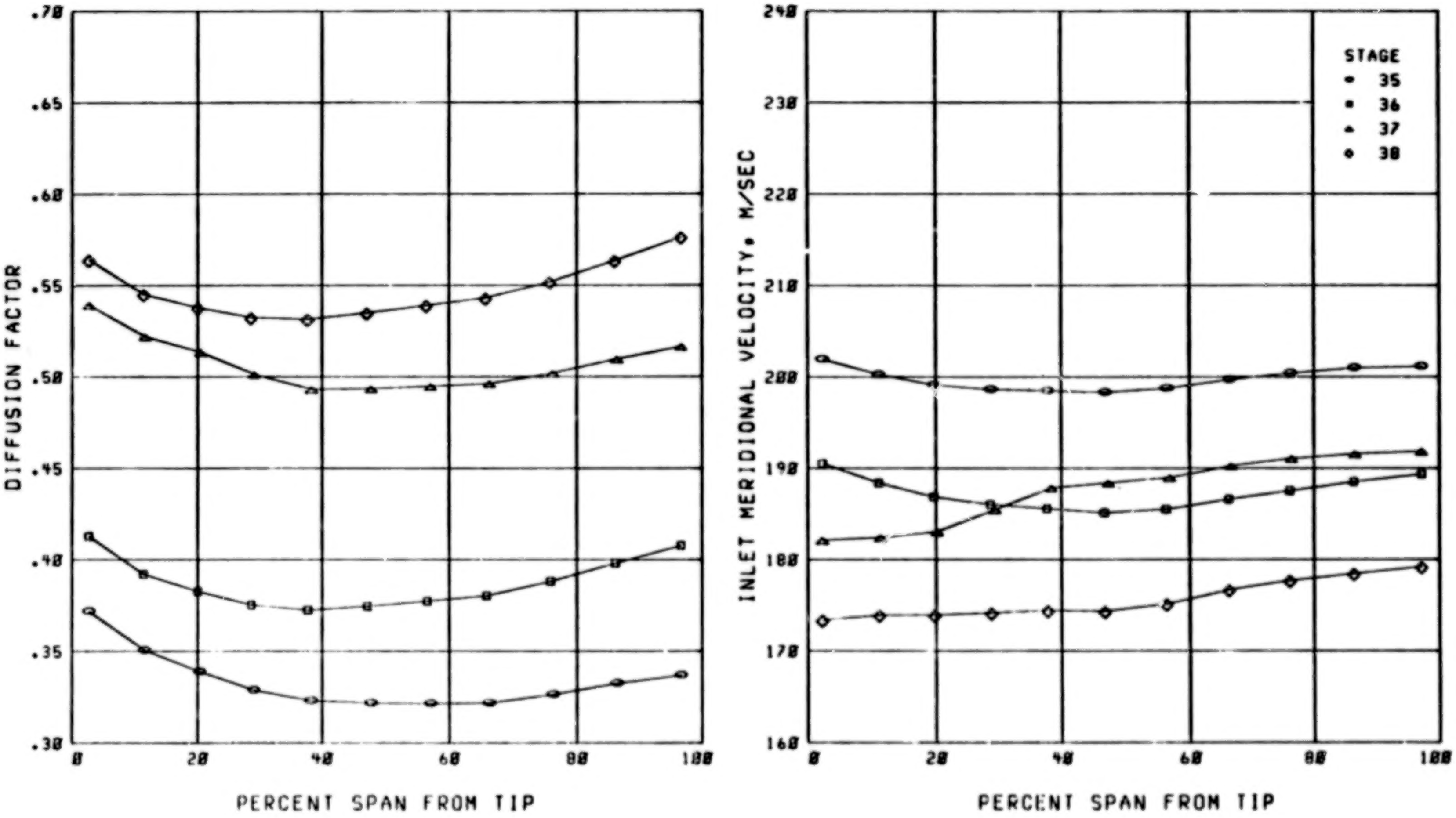
Figure 2. - Concluded.



(a) Inlet Mach number.

(b) Outlet Mach number.

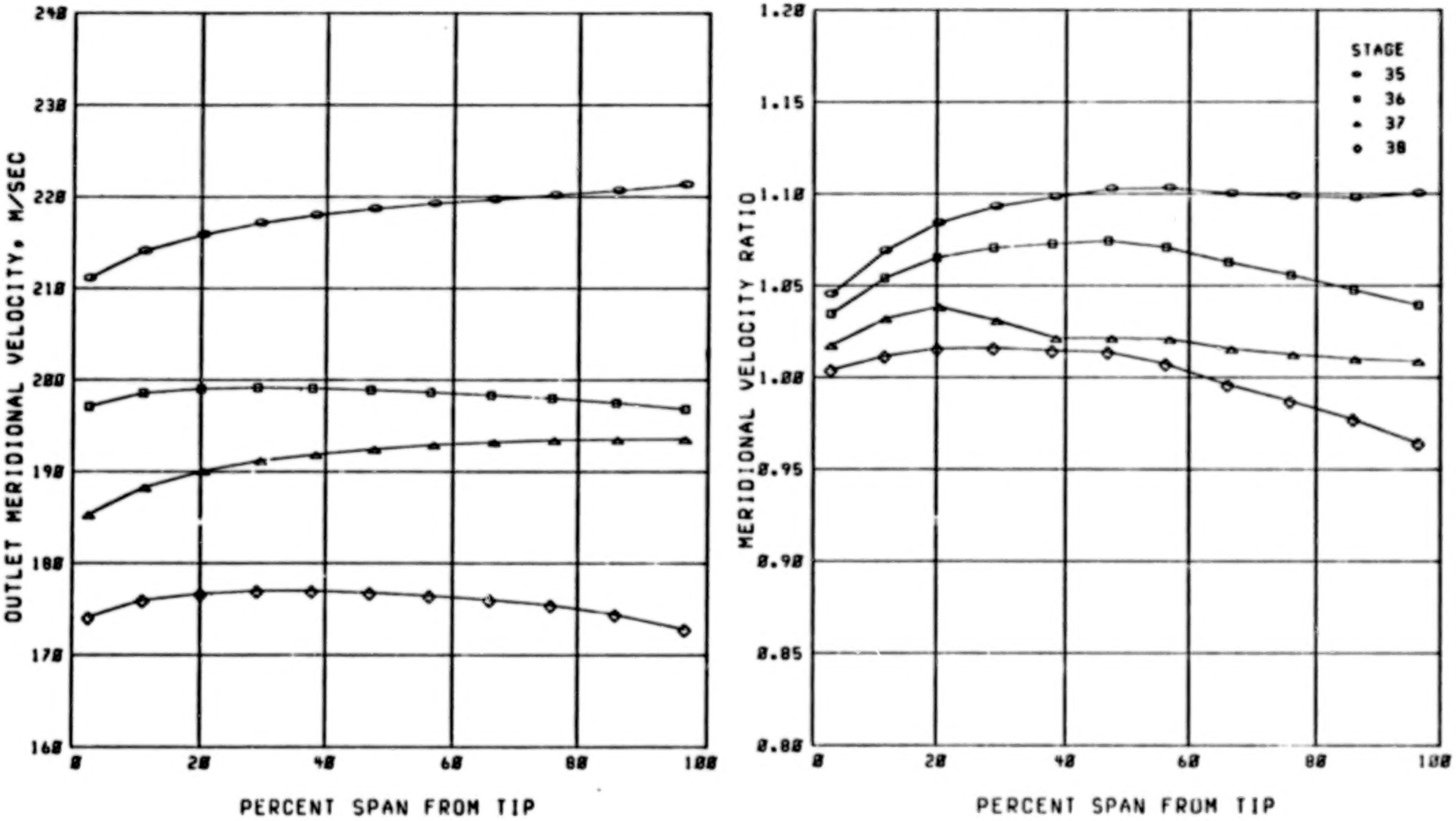
Figure 3. - Design radial distributions of stator blade parameters.



(c) Diffusion factor.

(d) Inlet meridional velocity.

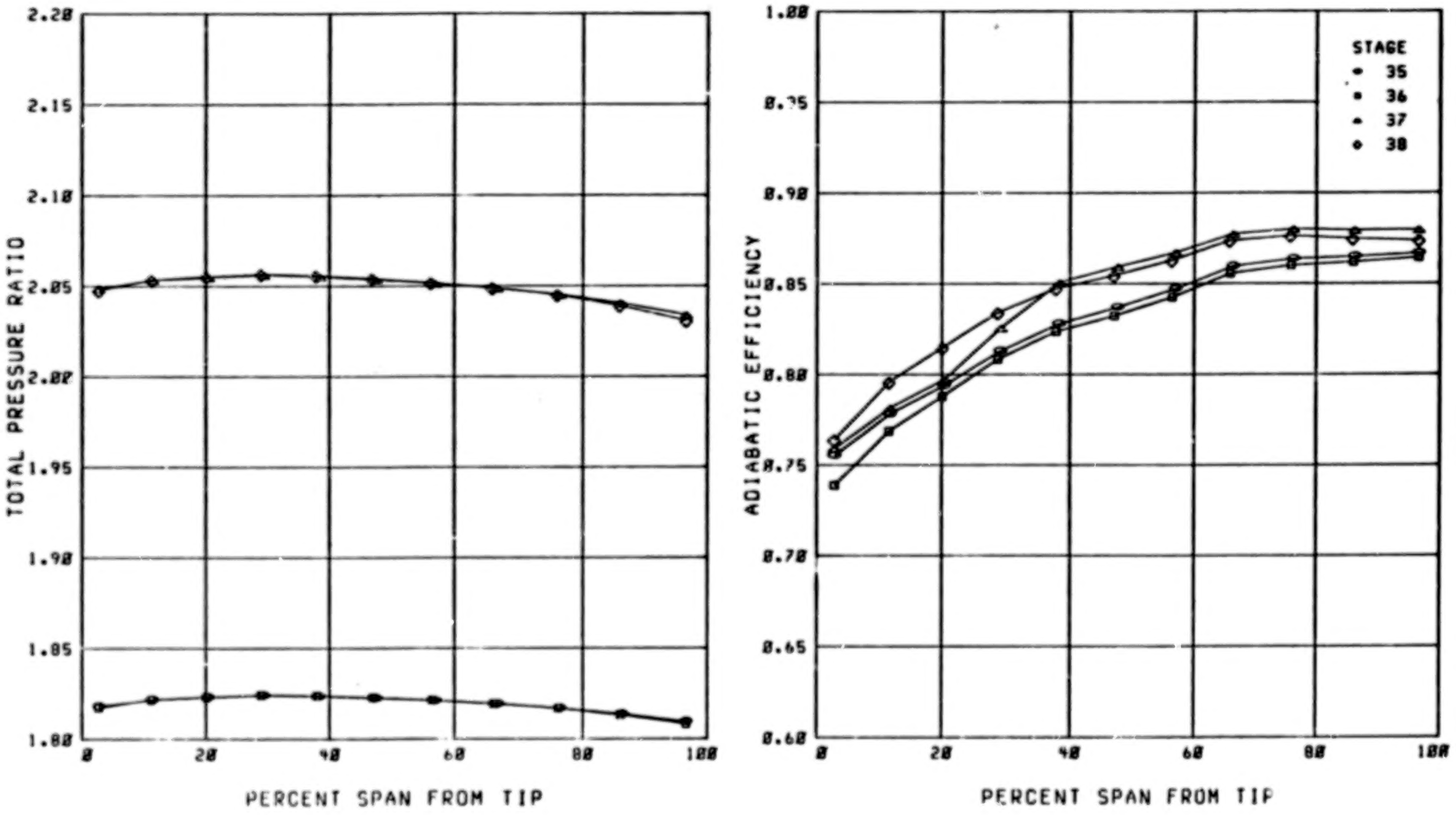
Figure 3. - Continued.



(e) Outlet meridional velocity.

(f) Meridional velocity ratio.

Figure 3. - Concluded.



(a) Total pressure ratio.

(b) Adiabatic efficiency.

Figure 4. - Design radial distributions of stage parameters.

CONTENTS

Page

SUMMARY 1 1/A5

INTRODUCTION 1 1/A5

AERODYNAMIC DESIGN 2 1/A6
- Velocity Diagrams 2 1/A6
- Loss Model 3 1/A7
- Blade Shapes 4 1/A8
  - Rotors 5 1/A9
  - Stators 6 1/A10

MECHANICAL DESIGN 7 1/A11

APPARATUS AND PROCEDURE 7 1/A11
- Compressor Test Facility 7 1/A11
- Test Stages 8 1/A12
- Instrumentation 8 1/A12
- Test Procedure 9 1/A13
- Calculation Procedure 9 1/A13

RESULTS AND DISCUSSION 10 1/A14
- Overall Performance 10 1/A14
  - Stage 35 . . . . 10 1/A14
  - Stage 36 . . . . 11 1/B1
  - Stage 37 . . . . 11 1/B1
  - Stage 38 . . . . 11 1/B1
- Effects of Design Pressure Ratio Level on Overall Performance 12 1/B2
- Effects of Aspect Ratio on Overall Performance 13 1/B3

SUMMARY OF RESULTS 13 1/B3

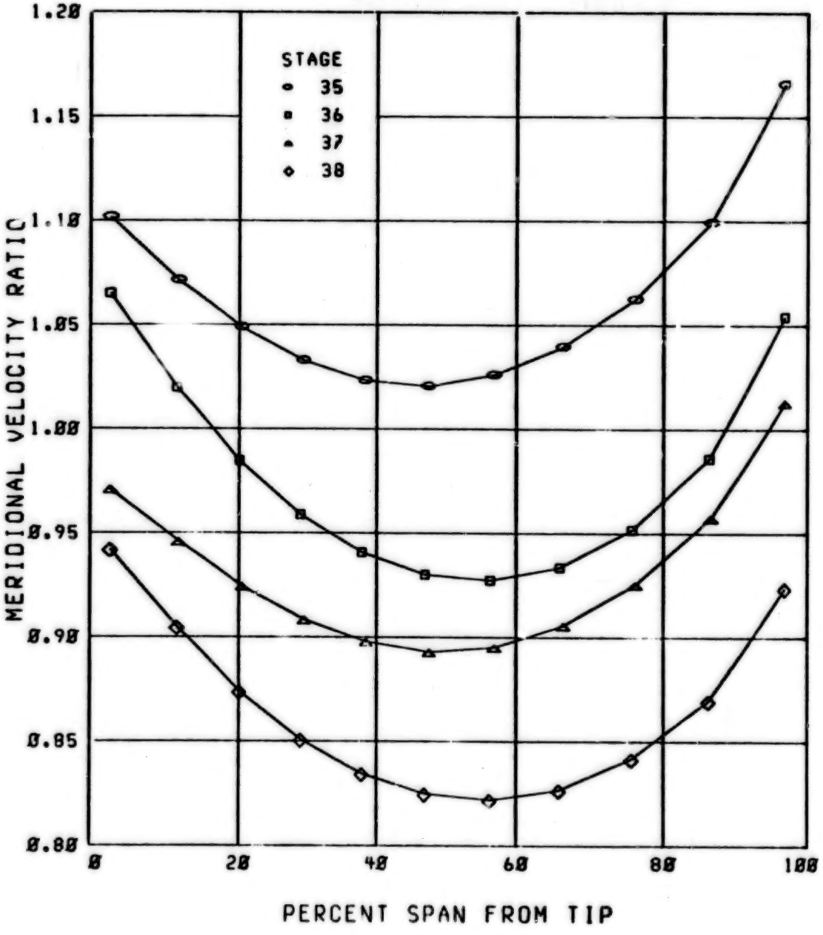
APPENDIXES

- A - SYMBOLS 15 1/B5
- B - EQUATIONS 18 1/B8
- C - BLADE MANUFACTURING COORDINATES 24 1/B14

REFERENCES 63 1/E11

TABLES 64 1/E12

FIGURES 77 1/F11



(c) Meridional velocity ratio.

Figure 4. - Concluded.

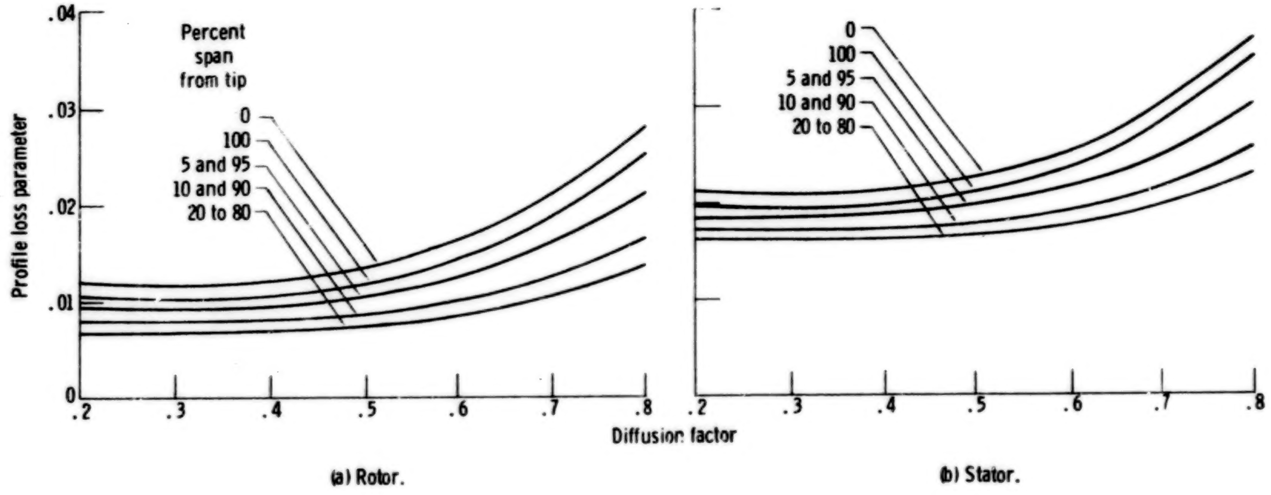


Figure 5. - Profile loss parameter as function of diffusion factor.

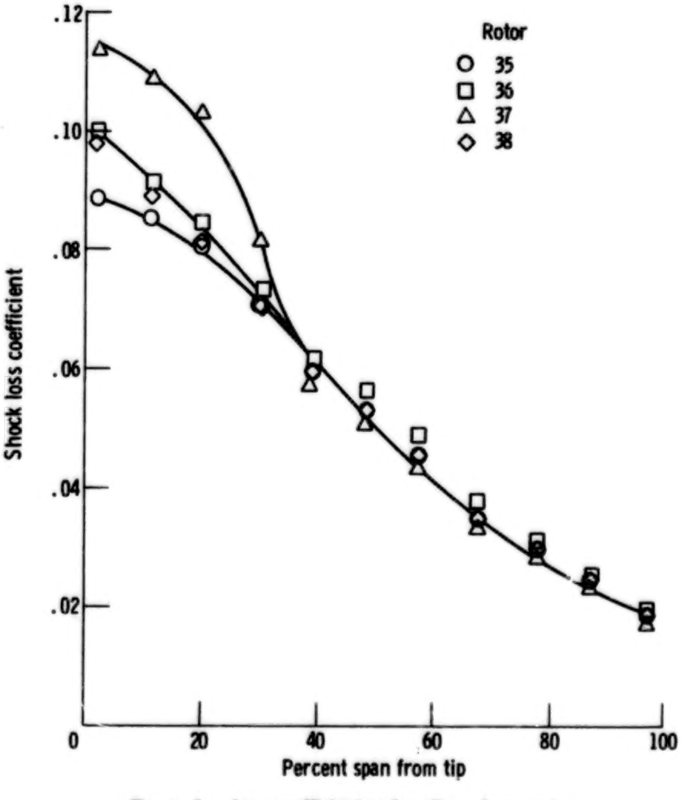
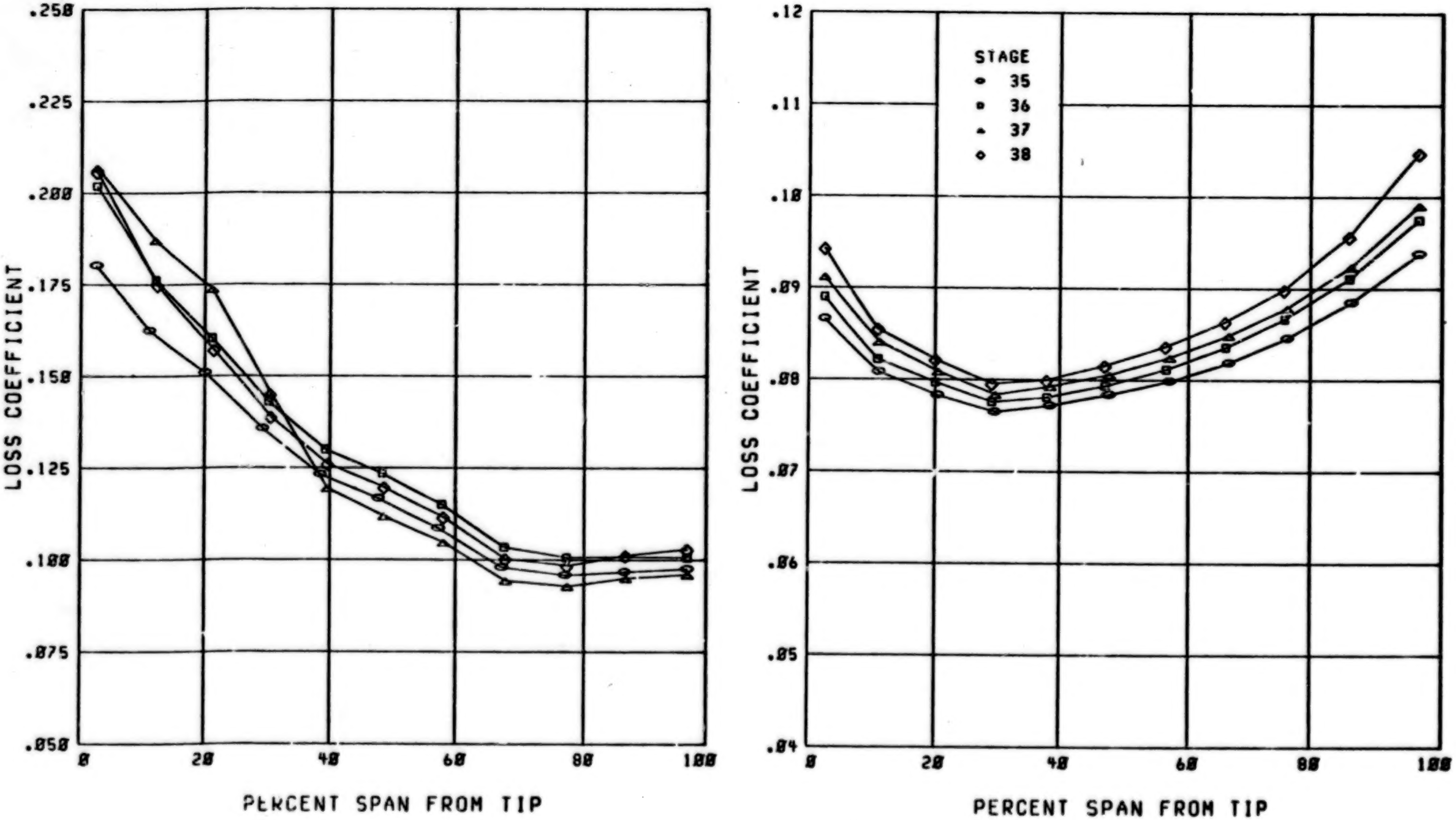


Figure 6. - Loss coefficient as function of percent span.



(a) Rotor.

(b) Stator.

Figure 7. - Radial distribution of total loss coefficient.

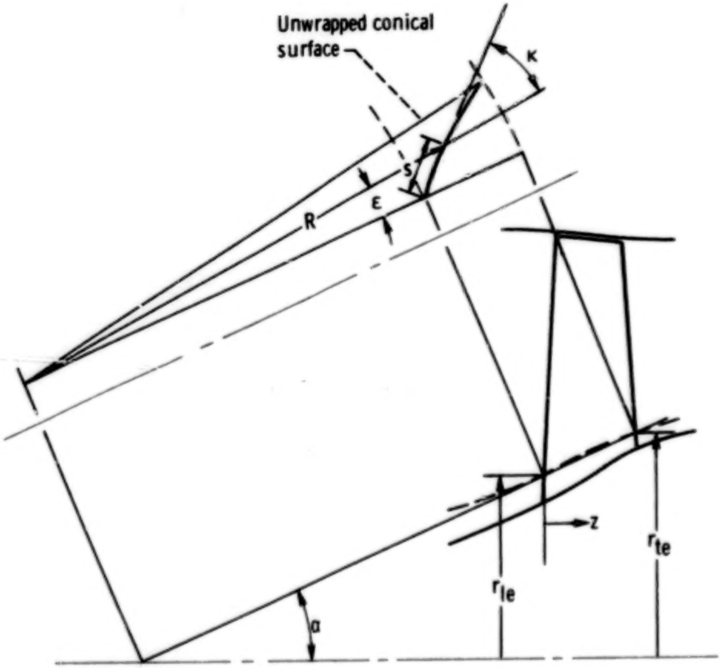
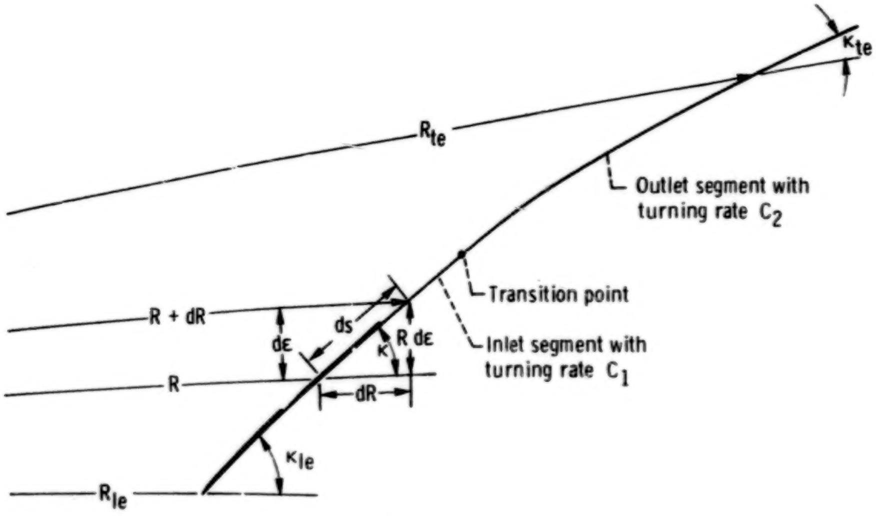
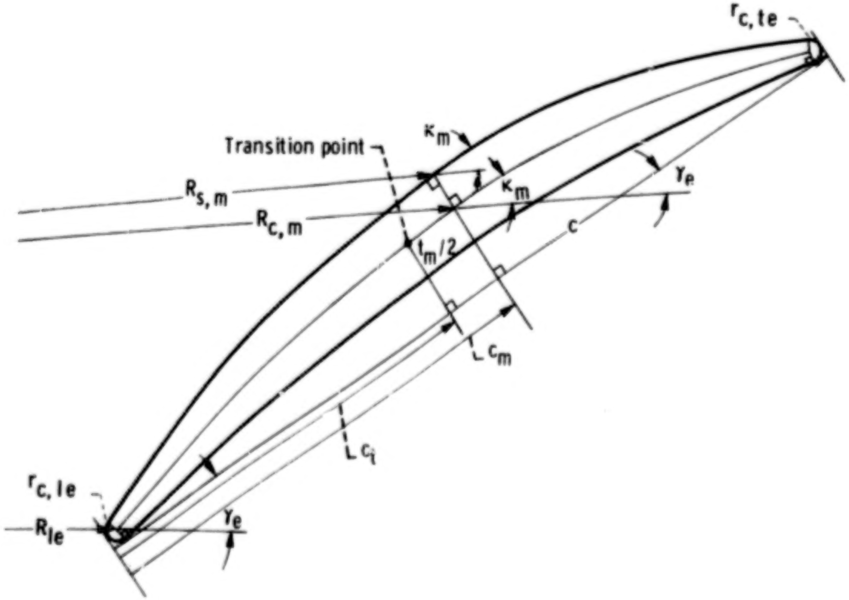

Unwrapped conical surface
κ
s
R
ε
z
r_{le}
r_{te}
α

Figure 8. - Conical coordinate system for blade-element layout.


κ_{te}
R_{te}
Outlet segment with turning rate C_2
Transition point
R + dR
ds
dε
R dε
κ
Inlet segment with turning rate C_1
R
dR
κ_{le}
R_{le}

(a) Centerline.


$r_{c,te}$
κ_m
Transition point
$R_{s,m}$
κ_m
γ_e
$R_{c,m}$
c
$t_m/2$
c_m
c_i
$r_{c,le}$
R_{le}
γ_e

(b) Suction and pressure surfaces.

Figure 9. - Blade-element layout parameters.

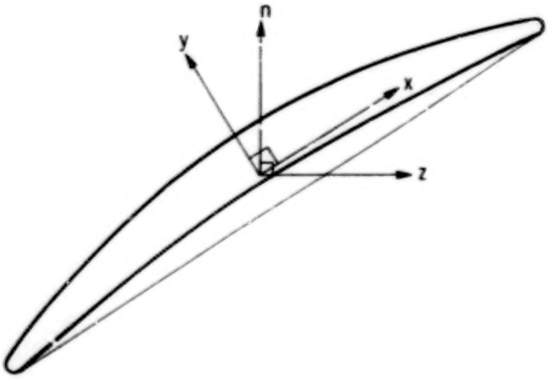


Figure 10. - Blade-section coordinate system on plane normal to radial line.

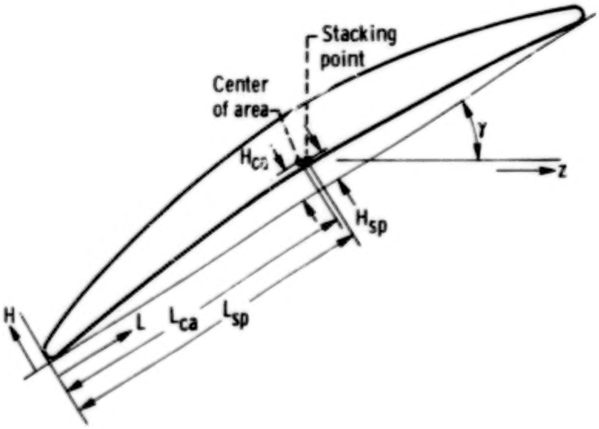

Stacking point
Center of area
H_{ca}
H_{sp}
γ
z
H
L
L_{ca}
L_{sp}

Figure 11. - Coordinate system for blade-section output data.

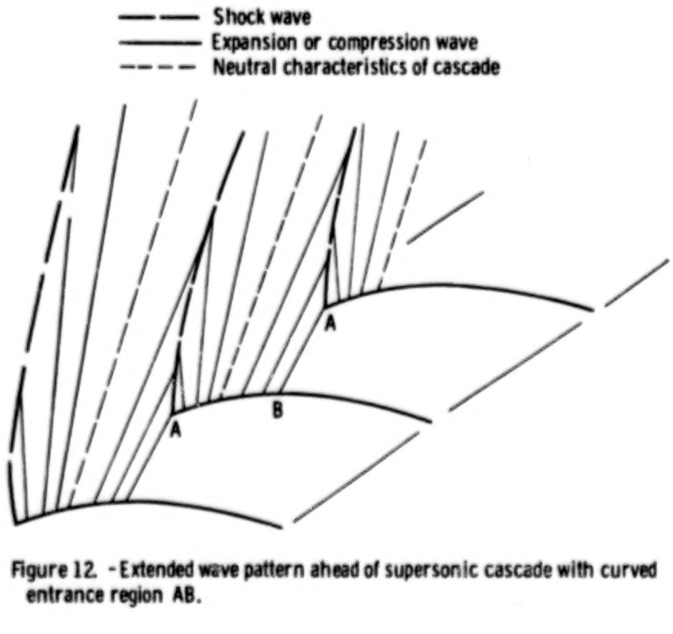
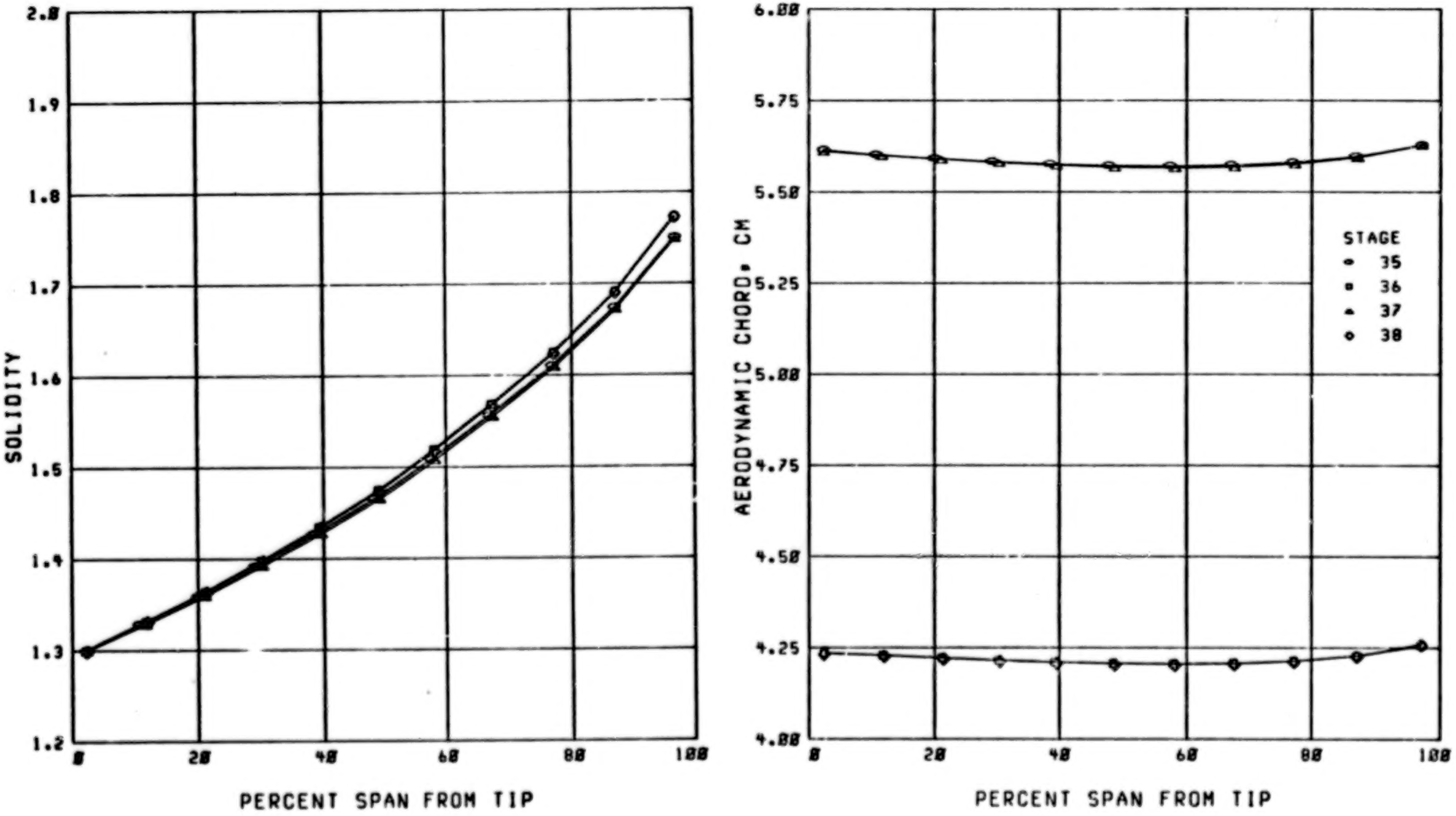

Shock wave
Expansion or compression wave
Neutral characteristics of cascade
A
B
A

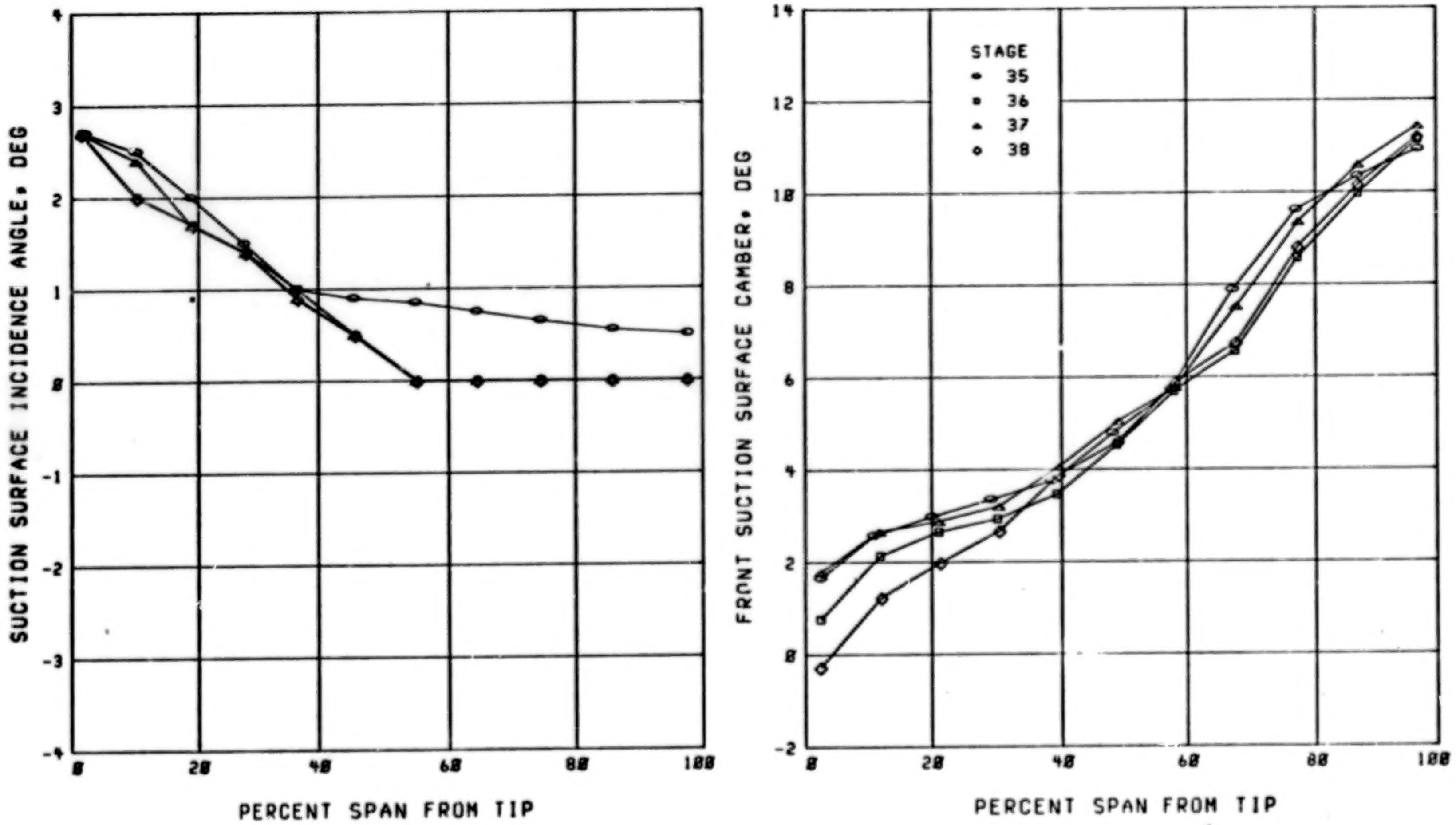
Figure 12. - Extended wave pattern ahead of supersonic cascade with curved entrance region AB.



(a) Solidity.

(b) Aerodynamic chord.

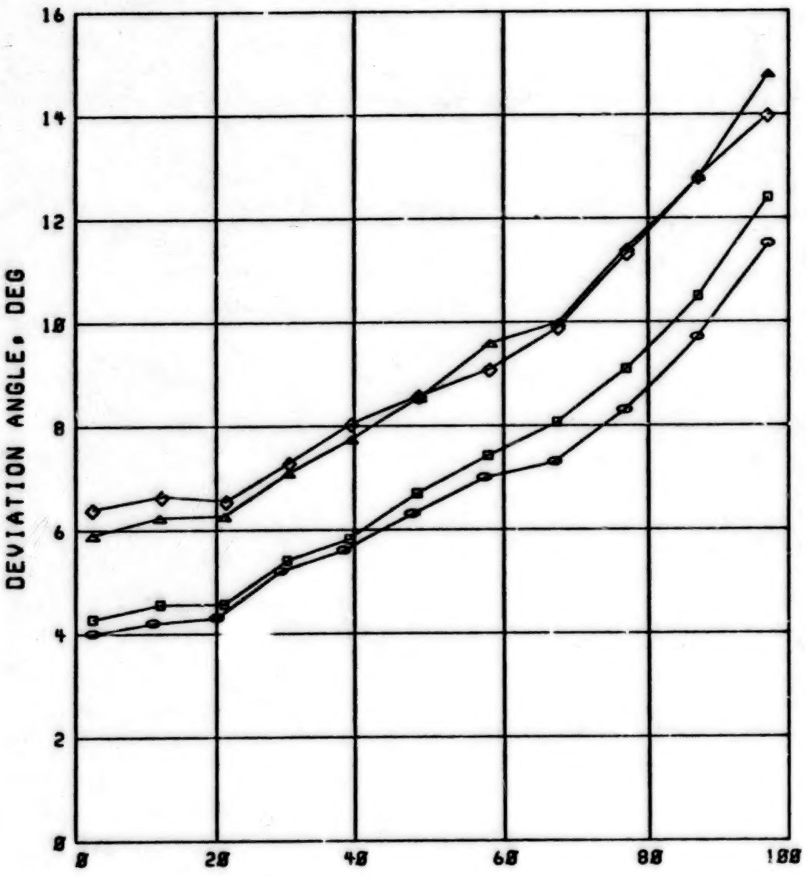
Figure 13. - Design radial distributions of rotor blade geometry parameters.



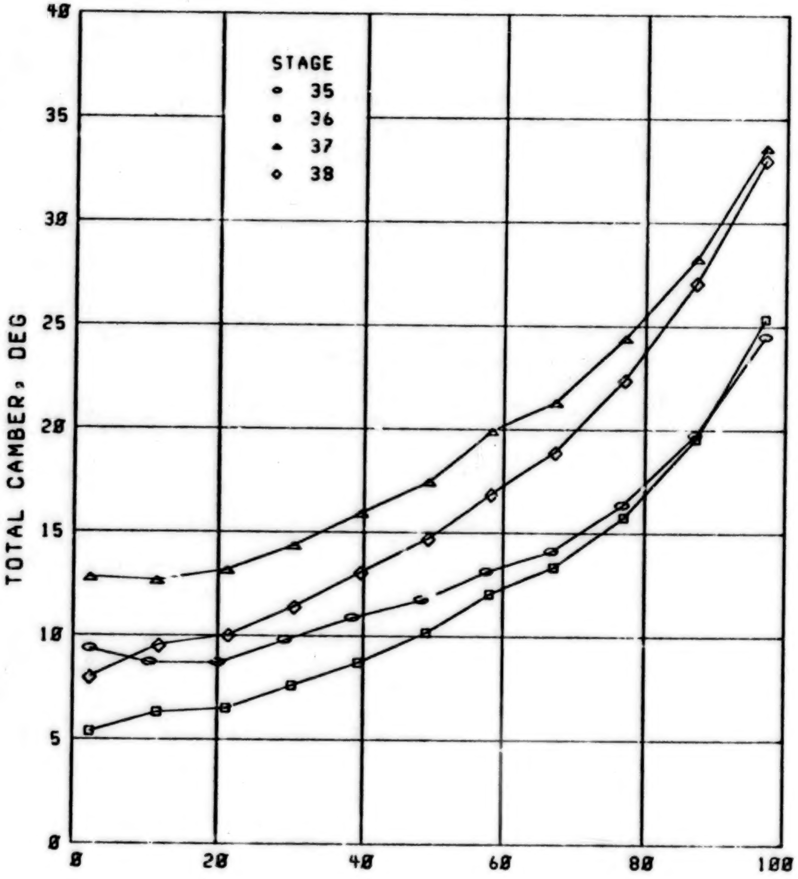
(c) Suction-surface incidence angle.

(d) Front suction-surface camber.

Figure 13. - Continued.

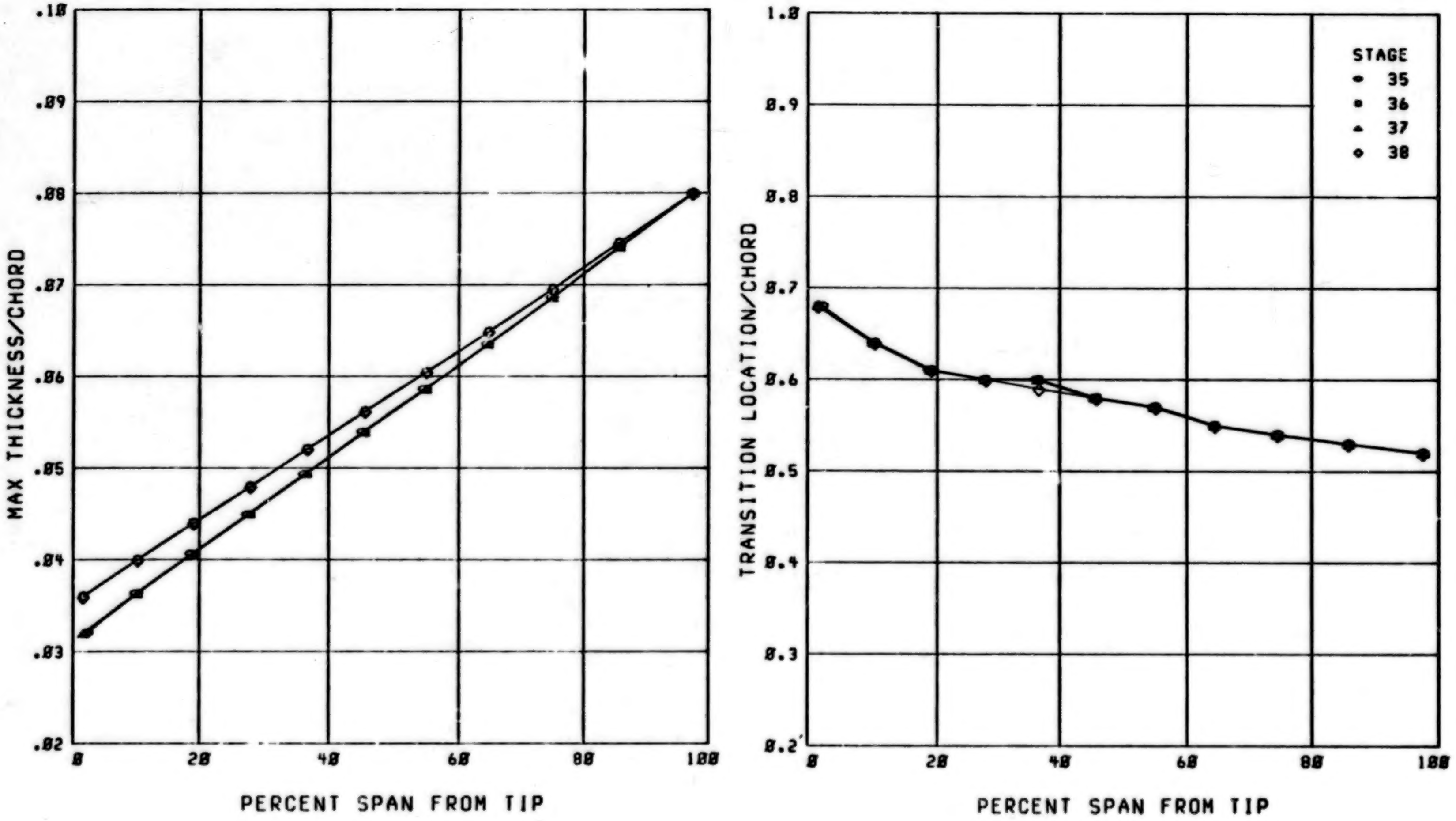


(e) Deviation angle.



(f) Total camber.

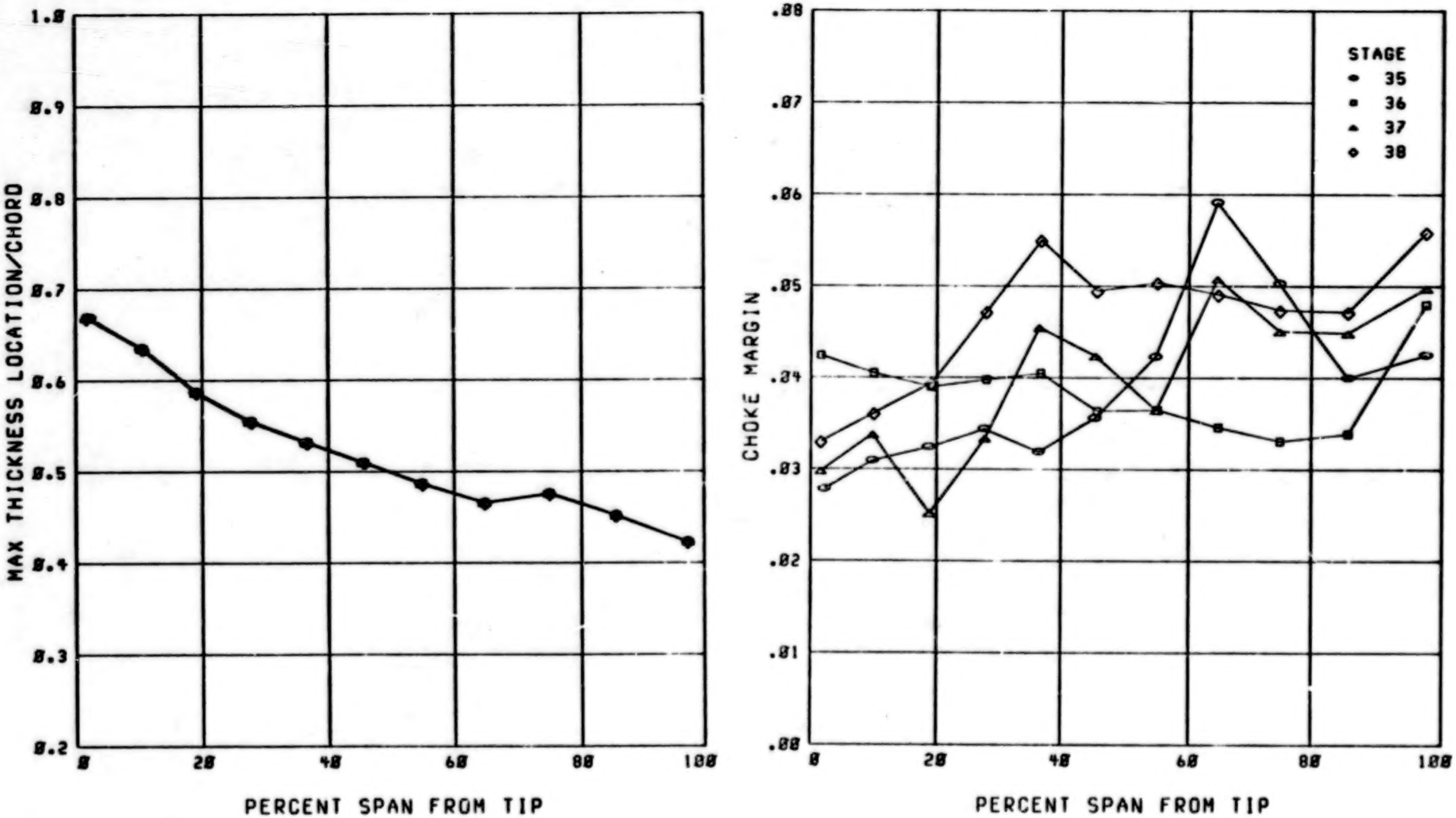
Figure 13. - Continued.



(g) Maximum thickness to chord ratio.

(h) Chordwise location of maximum thickness.

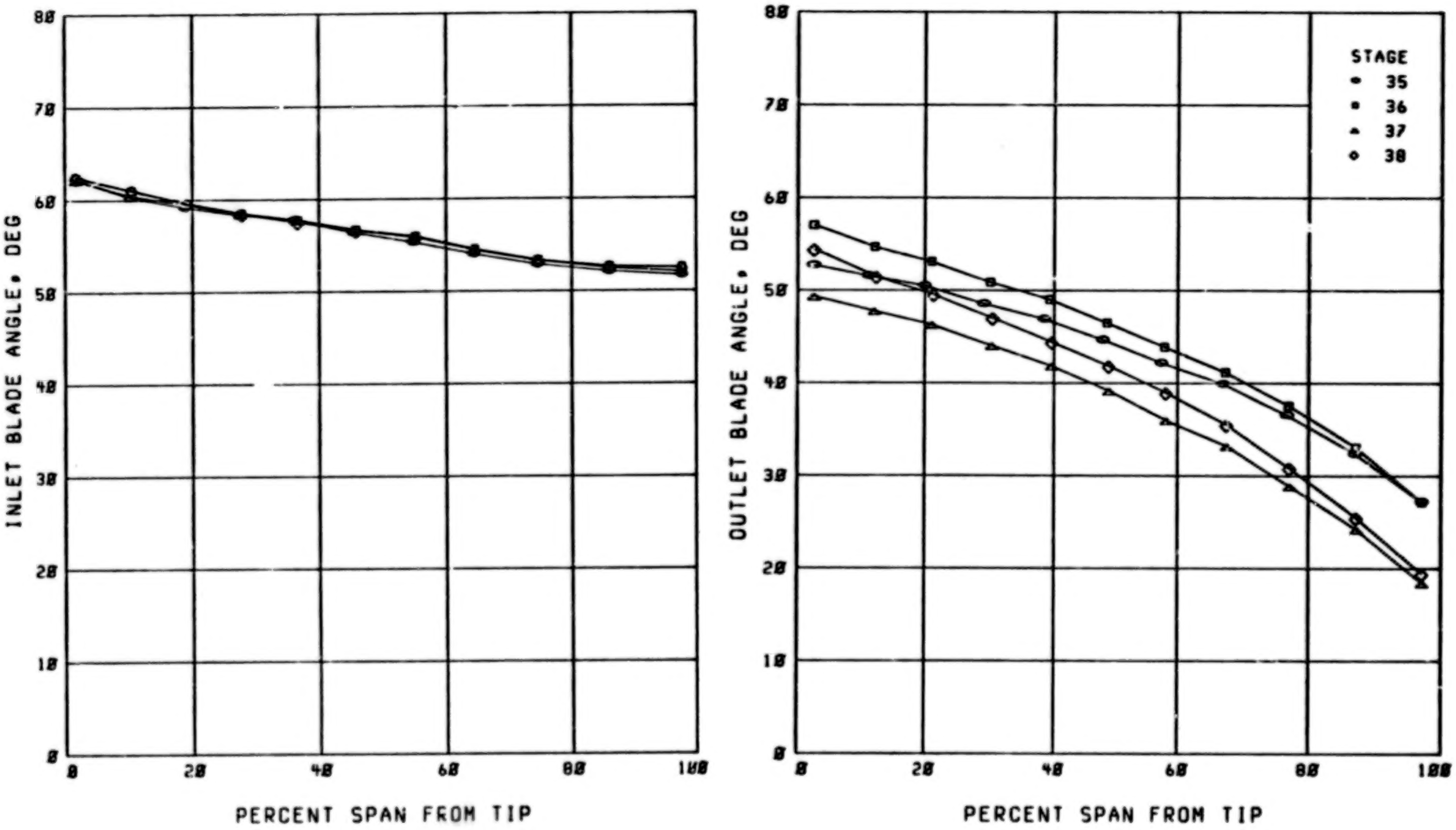
Figure 13. - Continued.



(i) Chordwise location of transition.

(j) Choke margin.

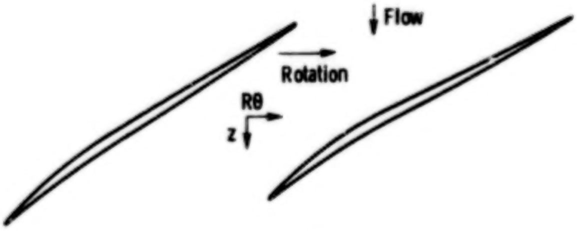
Figure 13. - Continued.



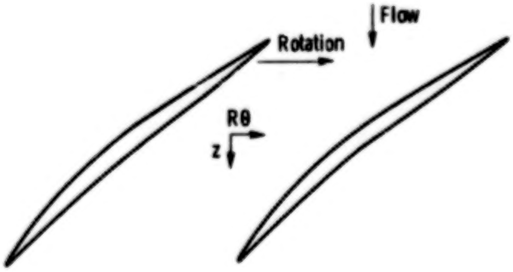
(k) Inlet blade angle.

(l) Outlet blade angle.

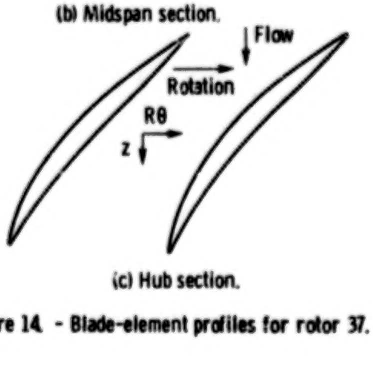
Figure 13. - Concluded.


Flow
Rotation
Rθ
z

(a) Tip section.

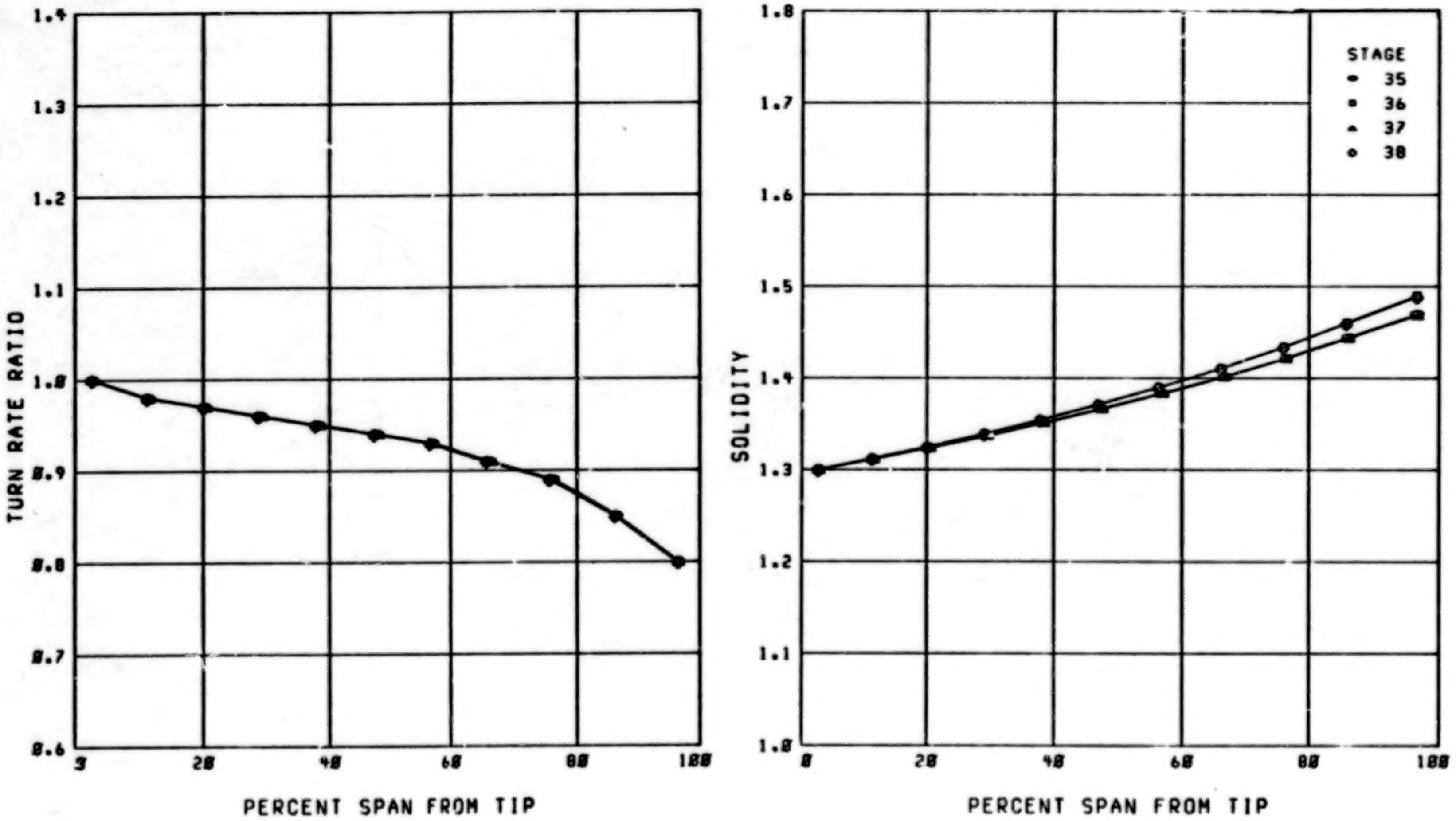

Flow
Rotation
Rθ
z

(b) Midspan section.


Flow
Rotation
Rθ
z

(c) Hub section.

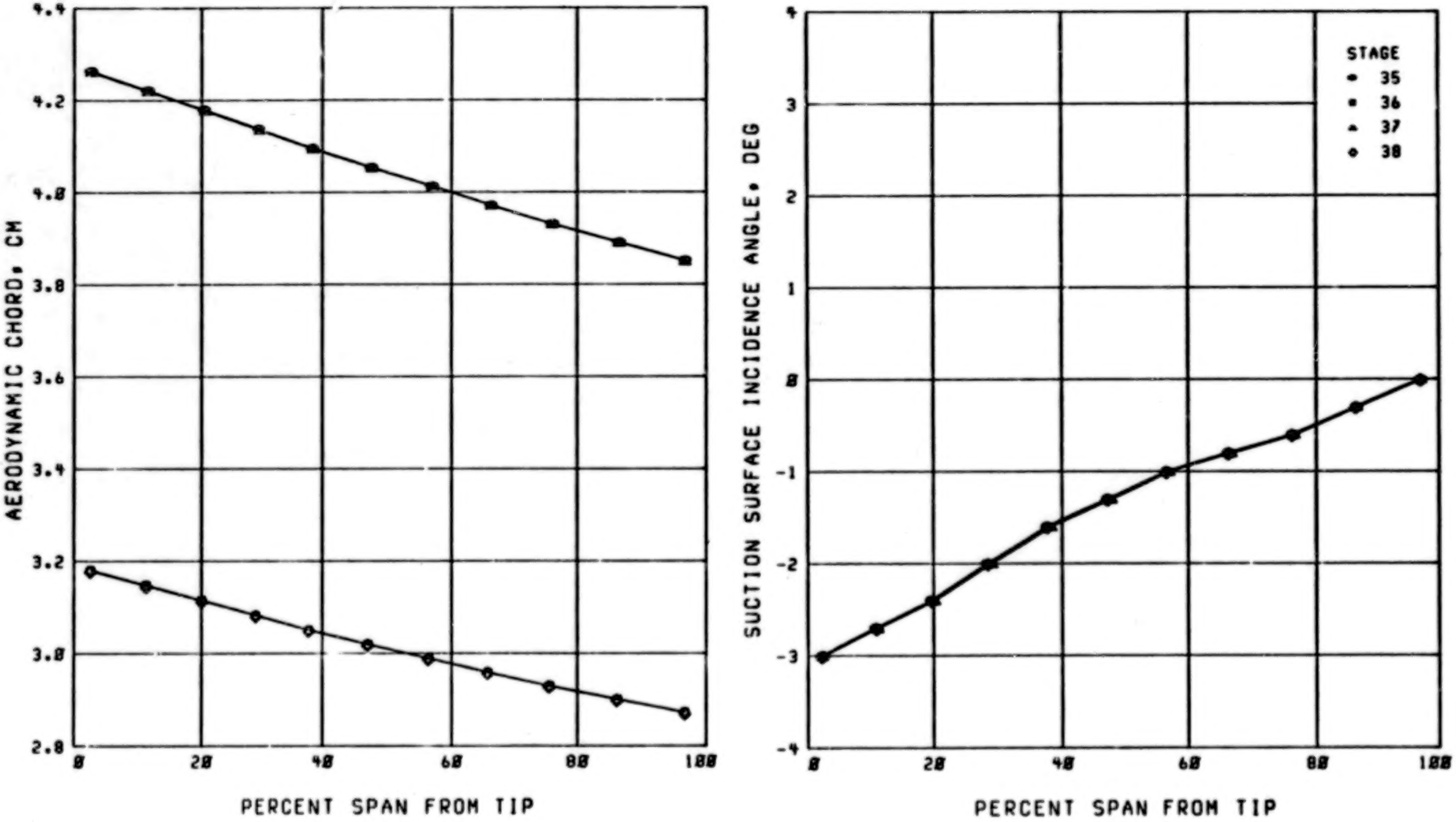
Figure 14. - Blade-element profiles for rotor 37.



(a) Turn rate ratio.

(b) Solidity.

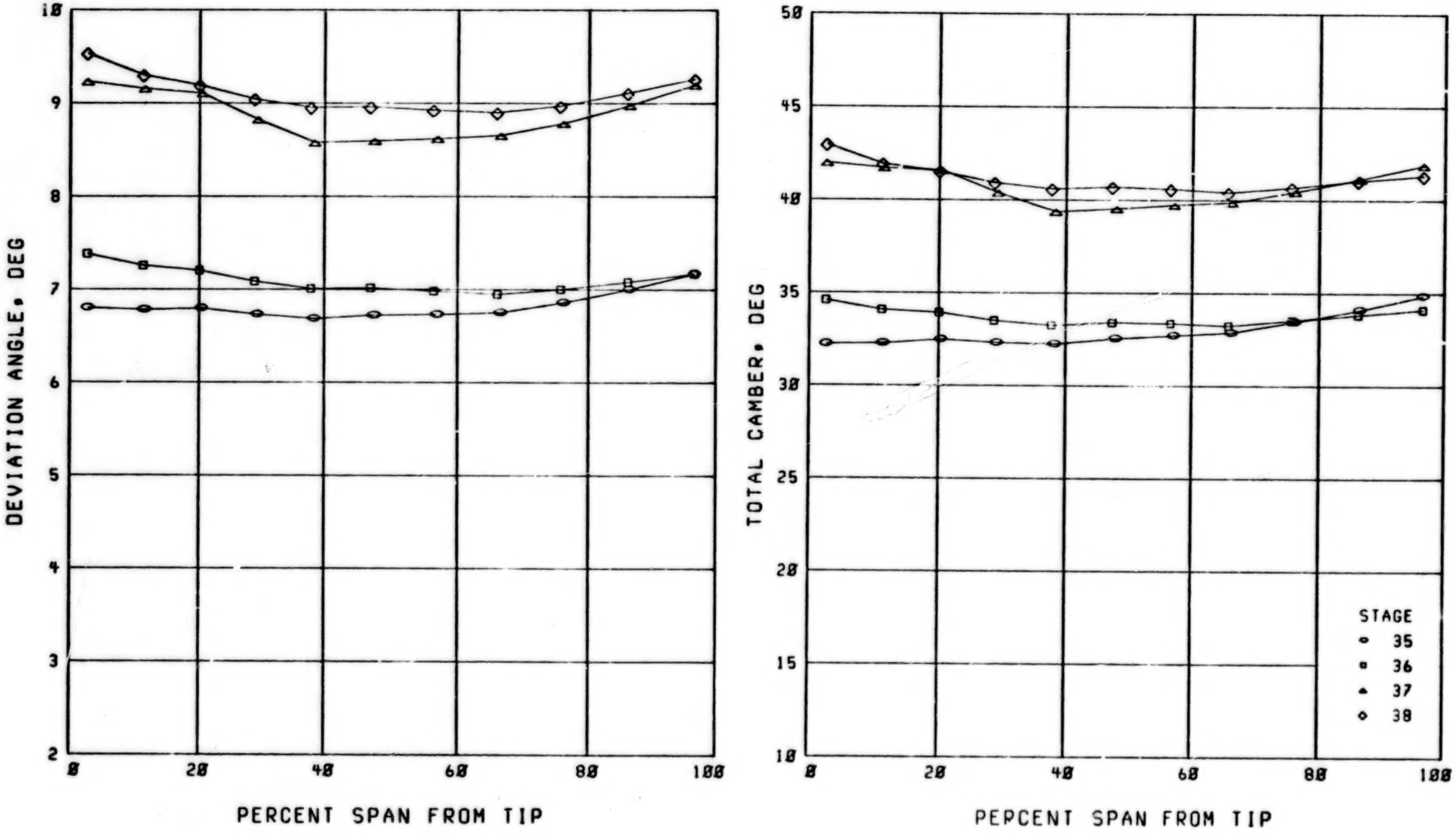
Figure 15. - Design radial distributions of stator blade geometry parameters.



(c) Aerodynamic chord.

(d) Suction-surface incidence angle.

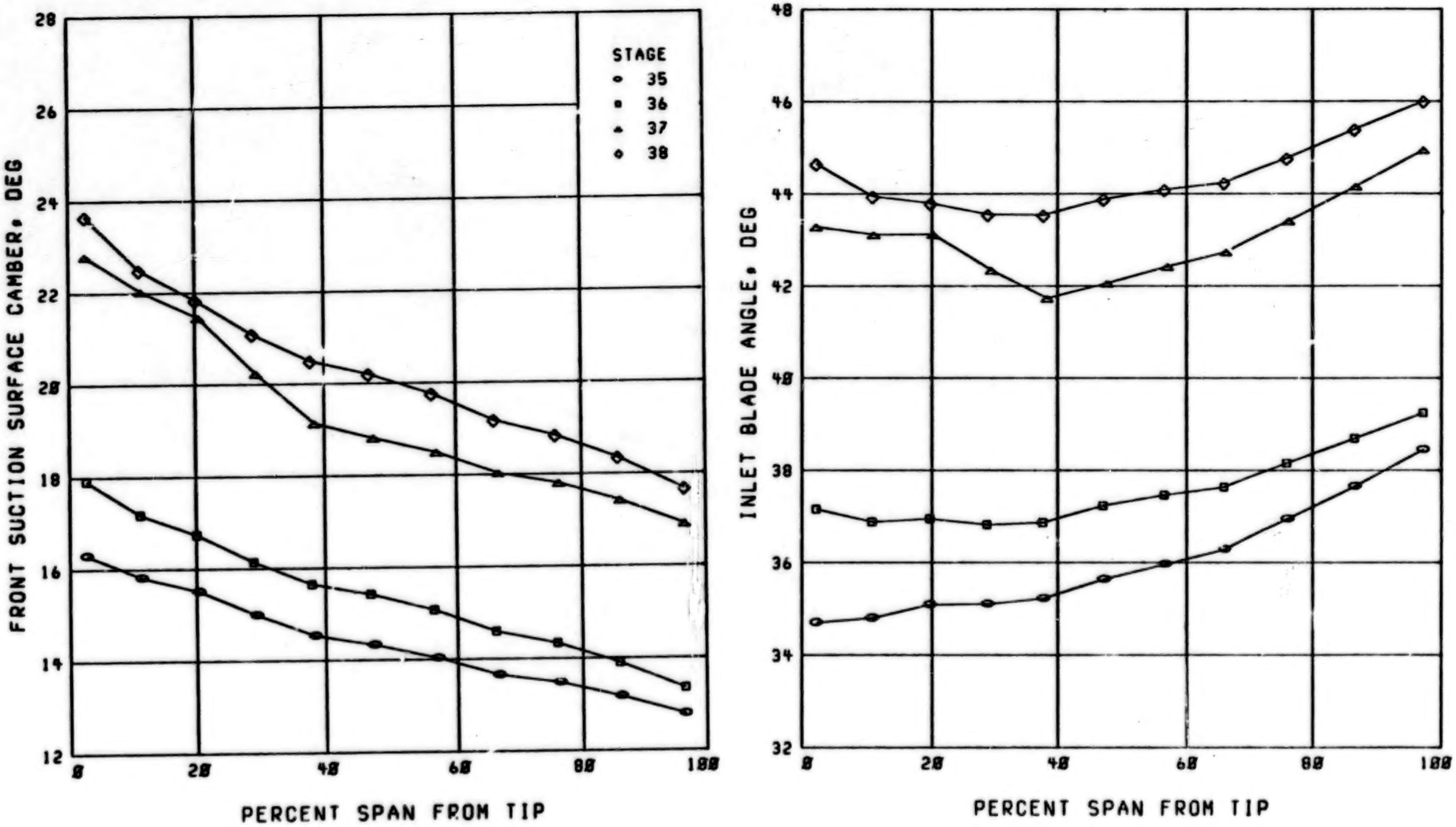
Figure 15. - Continued.



(e) Deviation angle.

(f) Total camber.

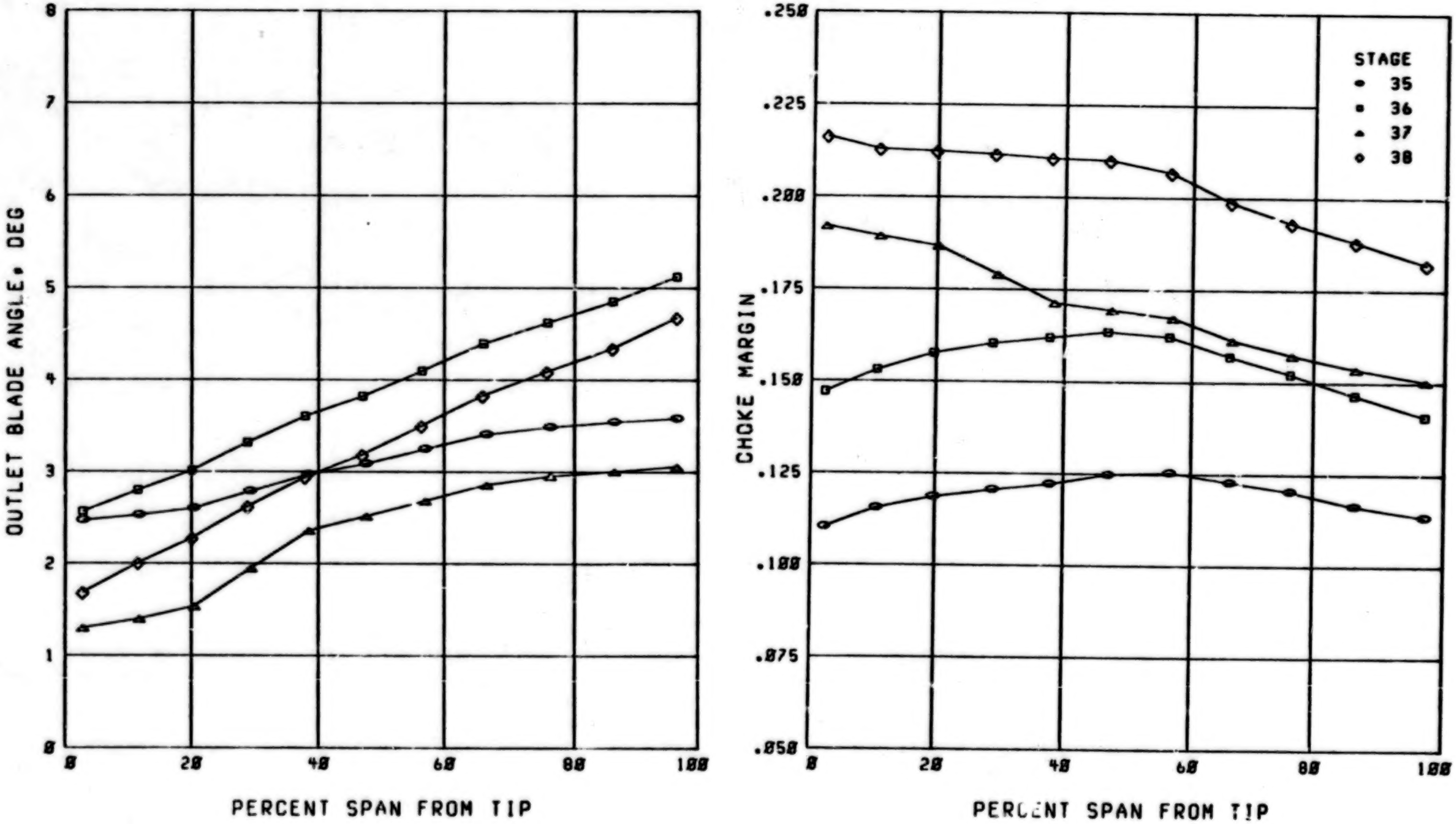
Figure 15. - Continued.



(g) Front suction-surface camber.

(h) Inlet-blade angle.

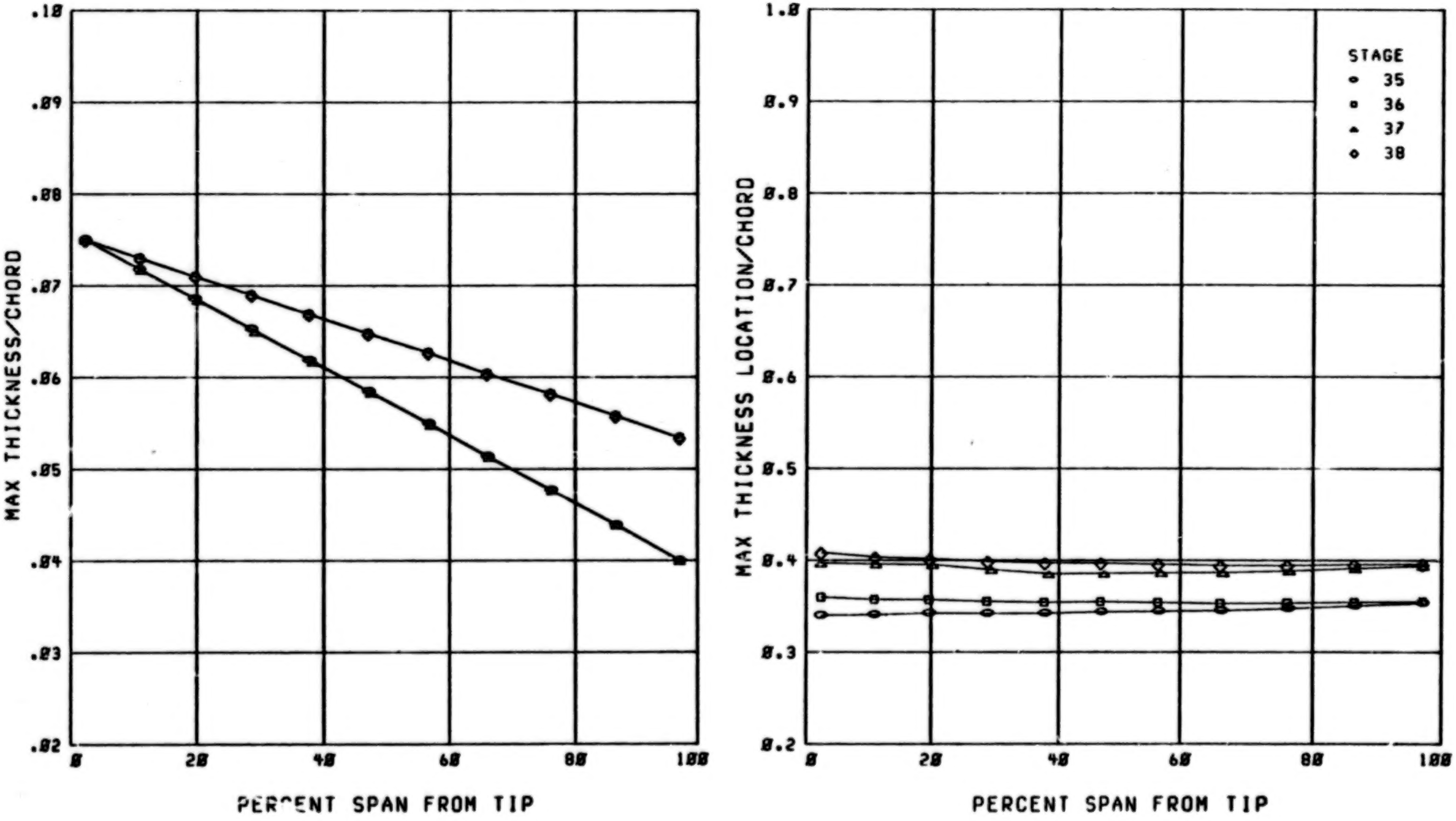
Figure 15. - Continued.



(i) Outlet blade angle.

(j) Choke margin.

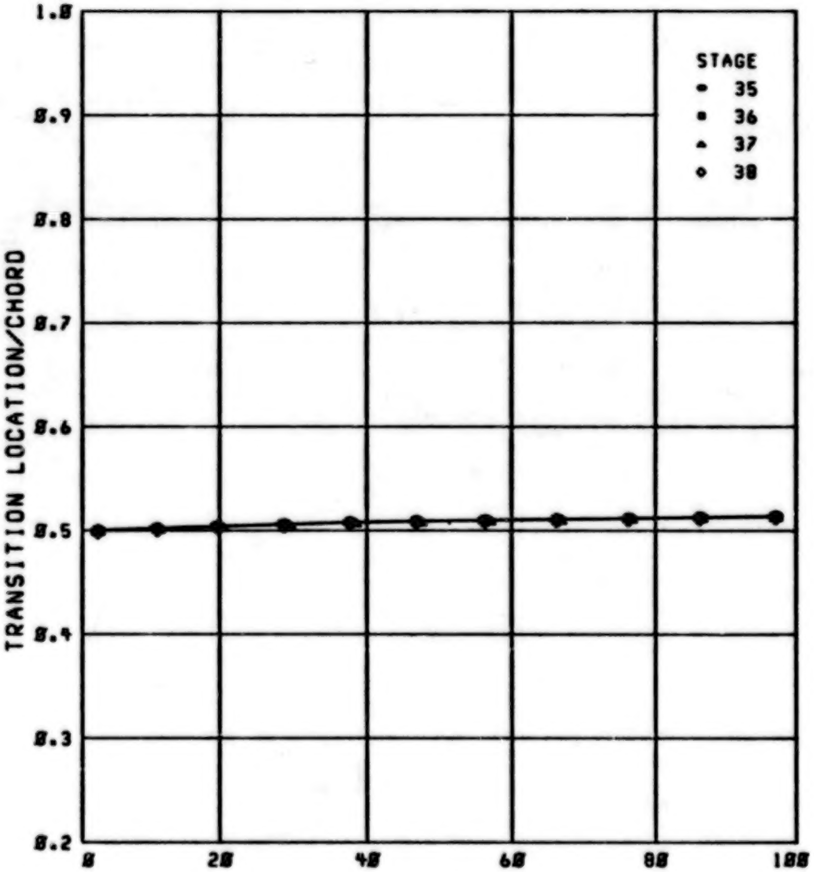
Figure 15. - Continued.



(k) Maximum thickness to chord ratio.

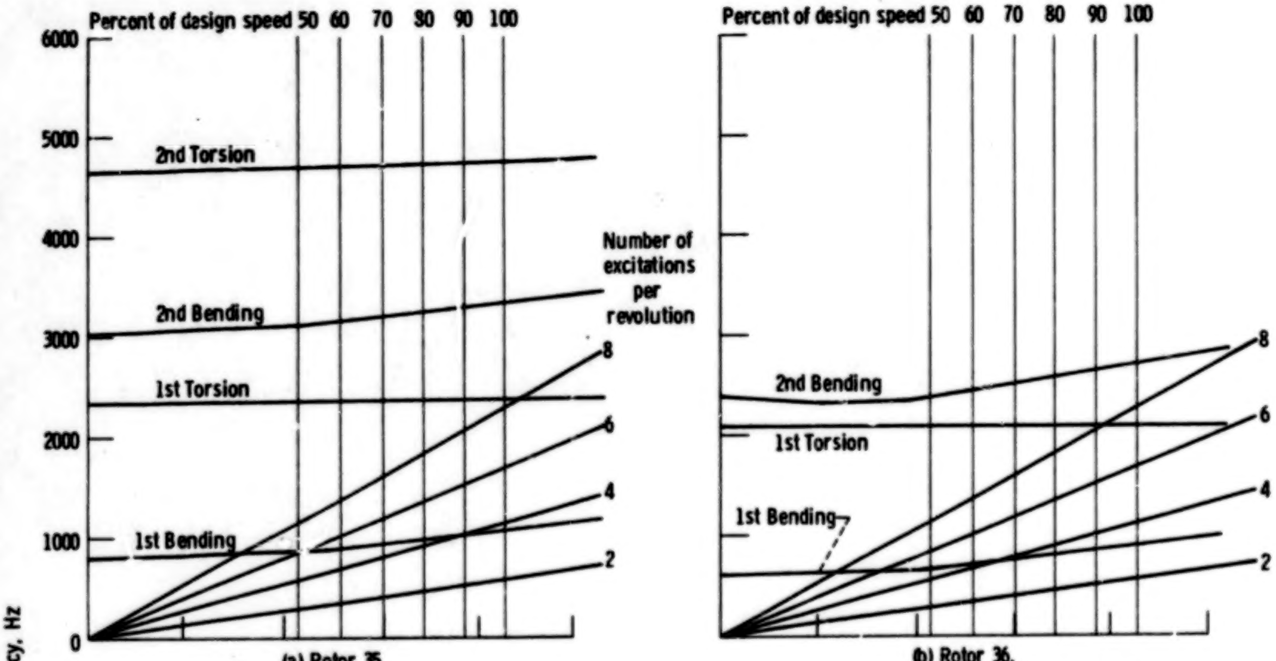
(l) Chordwise location of transition.

Figure 15. - Continued.



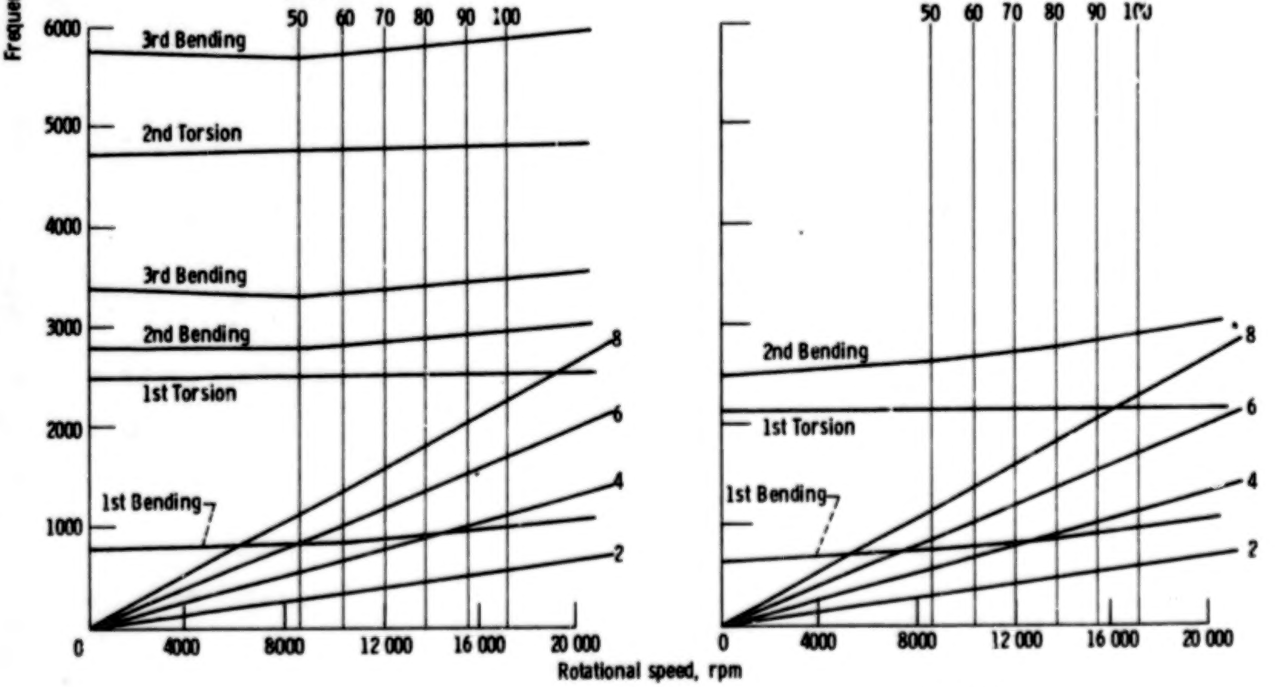
(m) Chordwise location of maximum thickness.

Figure 15. - Concluded.



(a) Rotor 35.

(b) Rotor 36.



(c) Rotor 37.

(d) Rotor 38.

Figure 16. - Campbell diagrams.

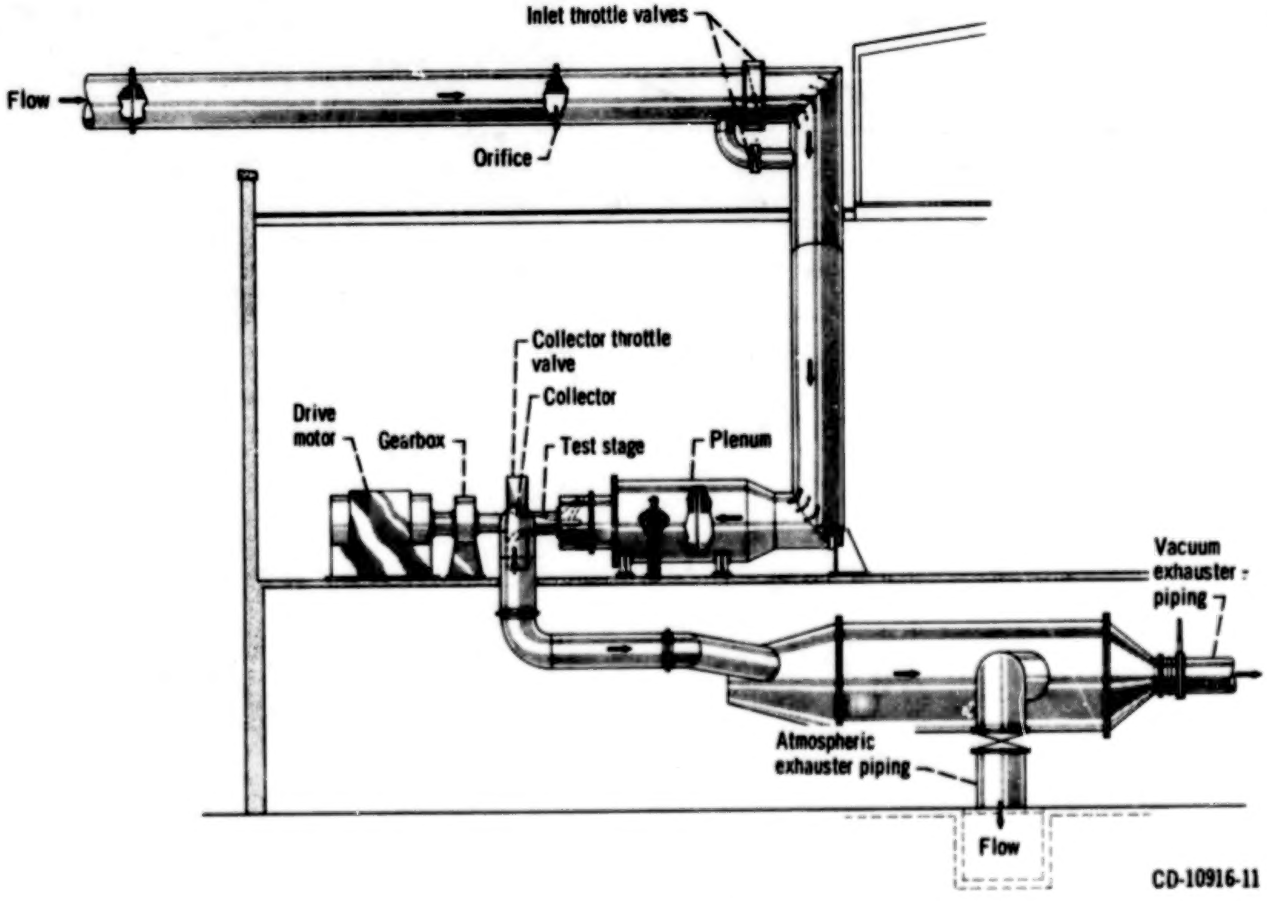
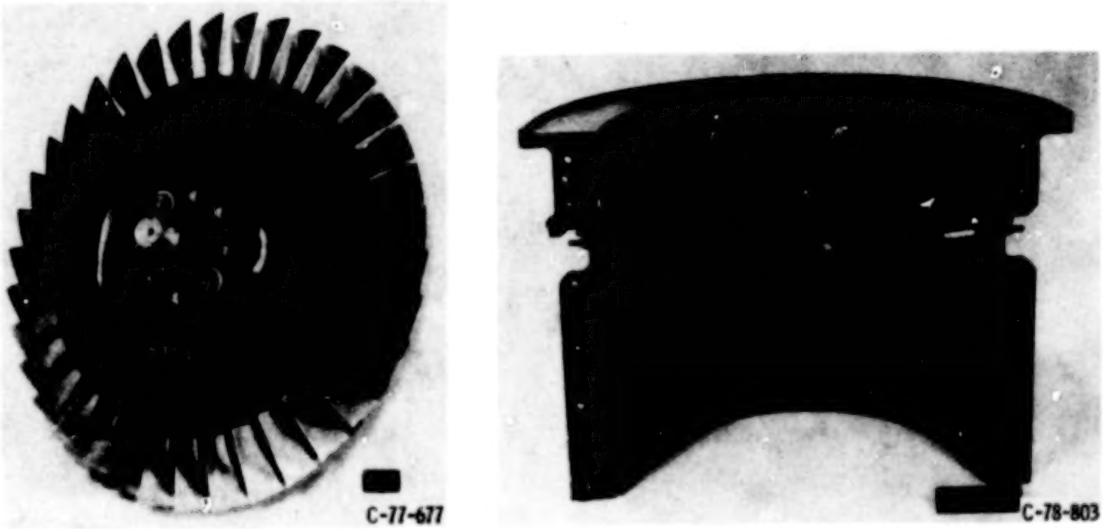
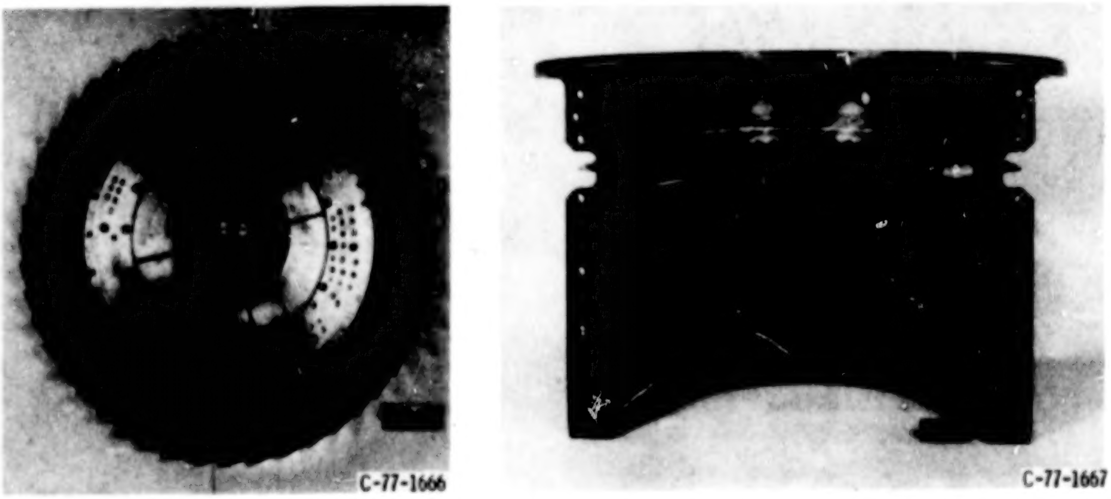

Inlet throttle valves
Flow
Orifice
Collector throttle valve
Collector
Drive motor
Gearbox
Test stage
Plenum
Vacuum exhauster piping
Atmospheric exhauster piping
Flow
CD-10916-11

Figure 17. - Compressor test facility.

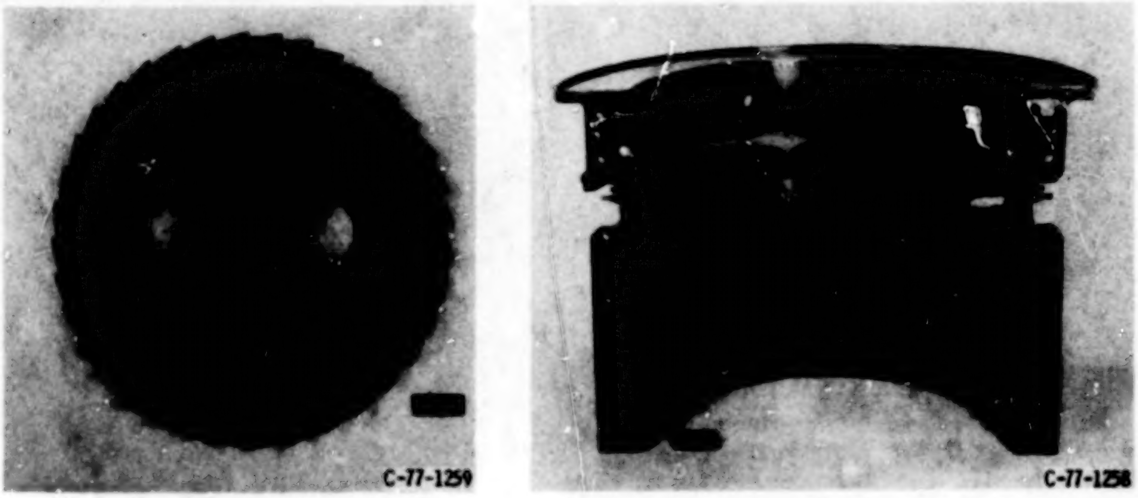

C-77-677
C-78-803

(a) Rotor 35. (b) Stator 35.


C-77-1666
C-77-1667

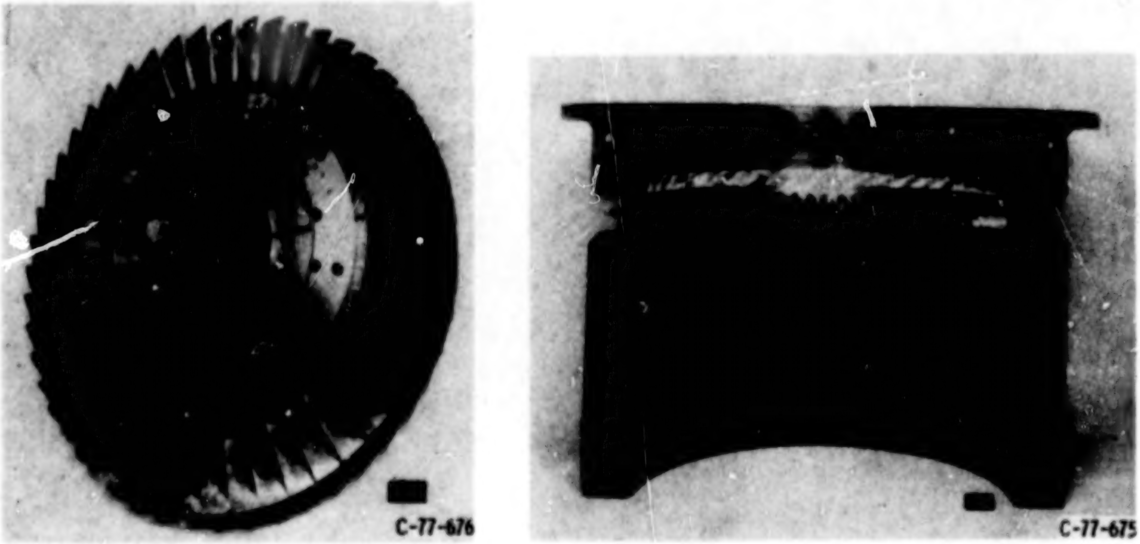
(c) Rotor 36. (d) Stator 36.

Figure 18. - Core compressor inlet stage blade rows.


C-77-1259
C-77-1258

(e) Rotor 37.

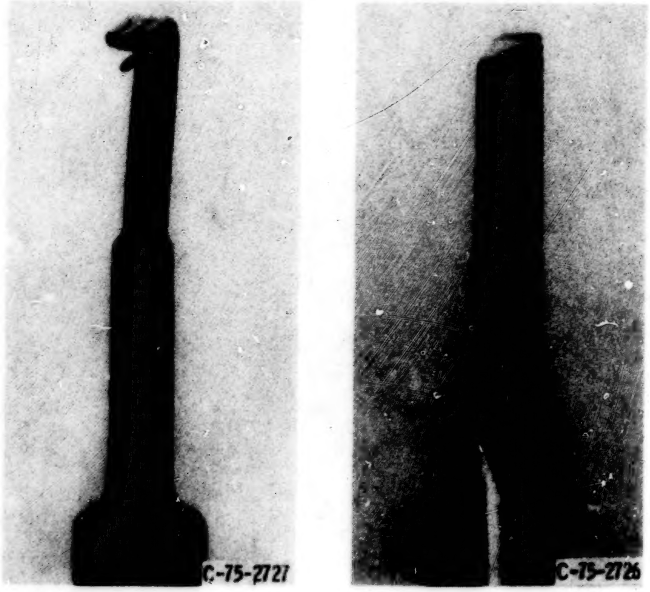
(f) Stator 37.


C-77-676
C-77-675

(g) Rotor 38.

(h) Stator 38.

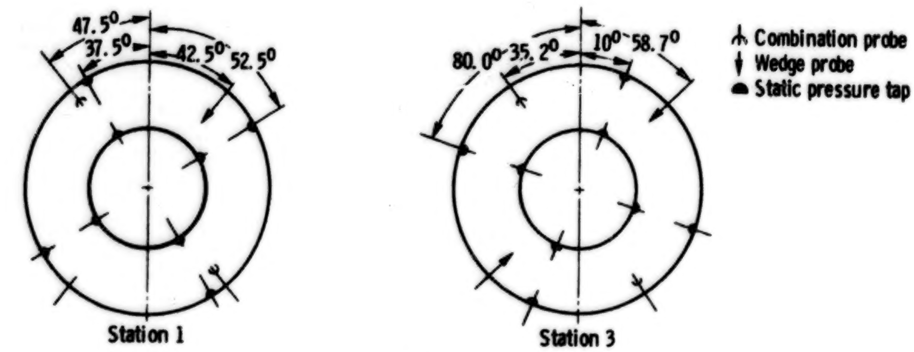
Figure 18. - Concluded.


C-75-2727
C-75-2726

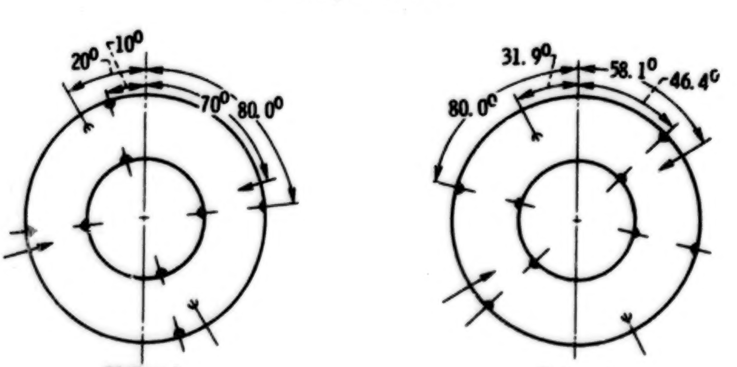
(a) Combination probe (total pressure, temperature, and flow angle).

(b) Wedge probe (static pressure and flow angle).

Figure 19. - Traverse probes.

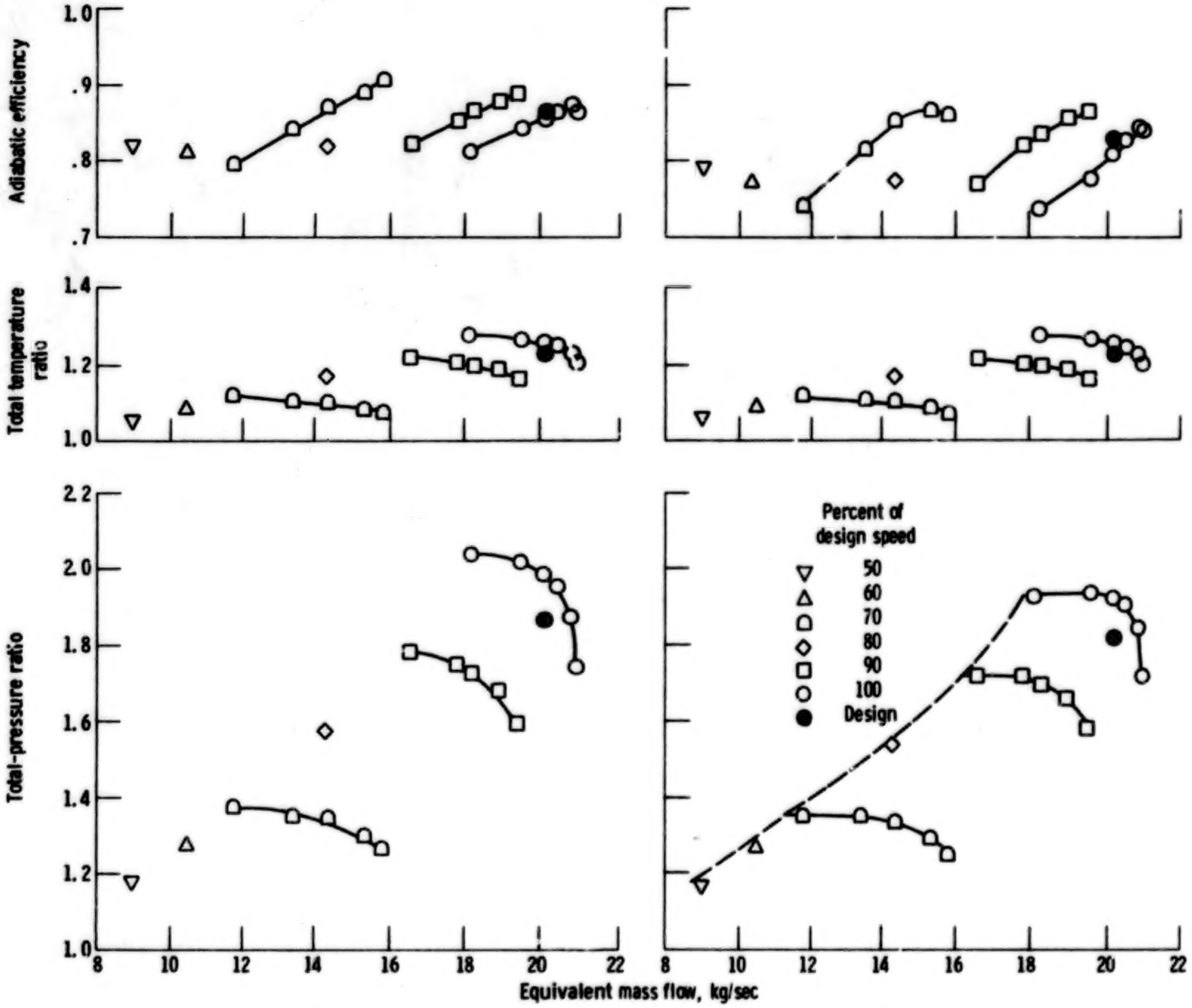

47.5°
37.5°
42.5°
52.5°
80.0°
35.2°
10°
58.7°
Combination probe
Wedge probe
Static pressure tap
Station 1
Station 3

(a) Stages 35 and 37.


20°
10°
70°
80.0°
31.9°
58.1°
46.4°
80.0°
Station 1
Station 3

(b) Stages 36 and 38.

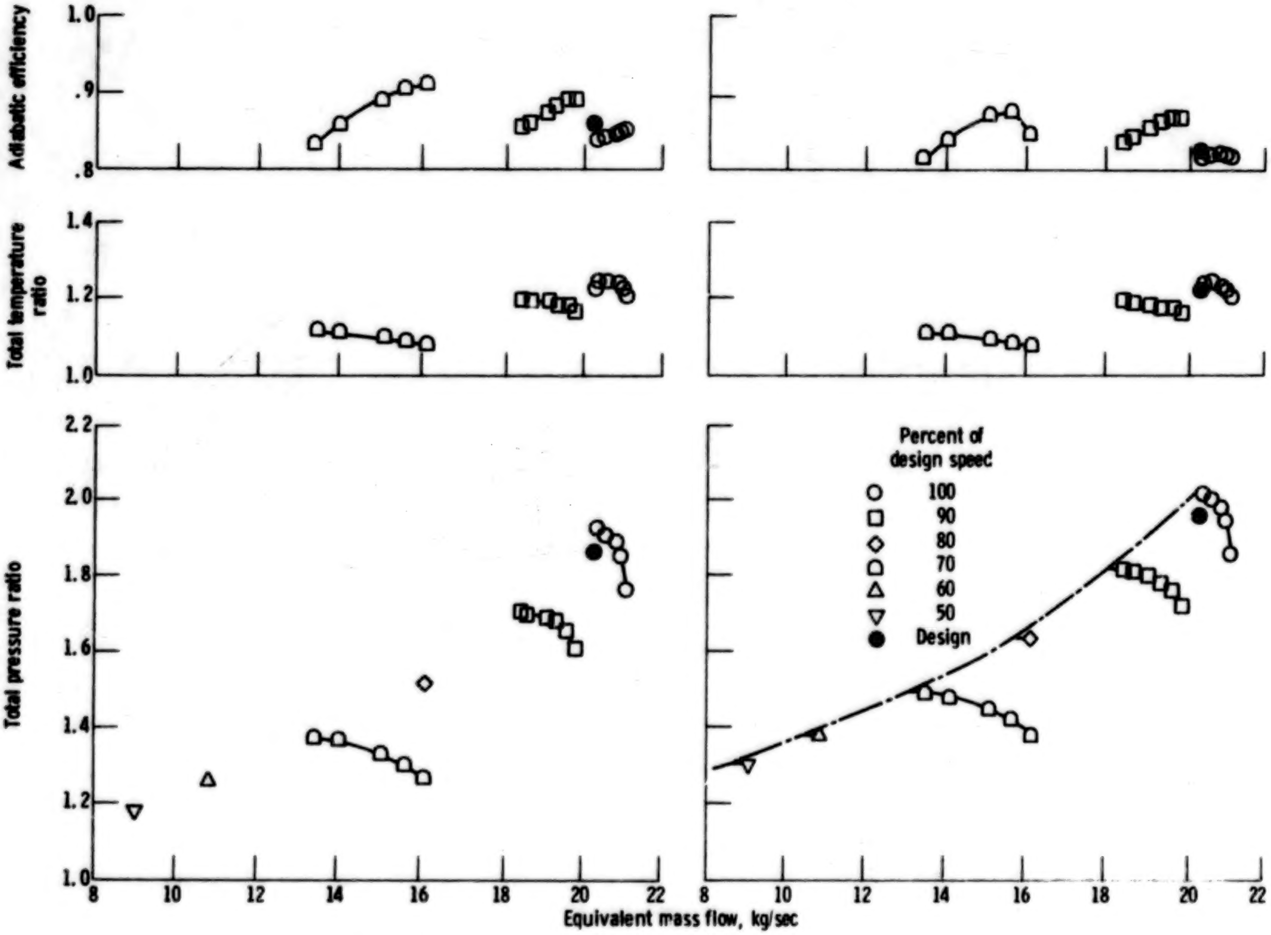
Figure 20. - Circumferential location of instrumentation at measuring station (facing upstream).



(a) Rotor 35.

(b) Stage 35.

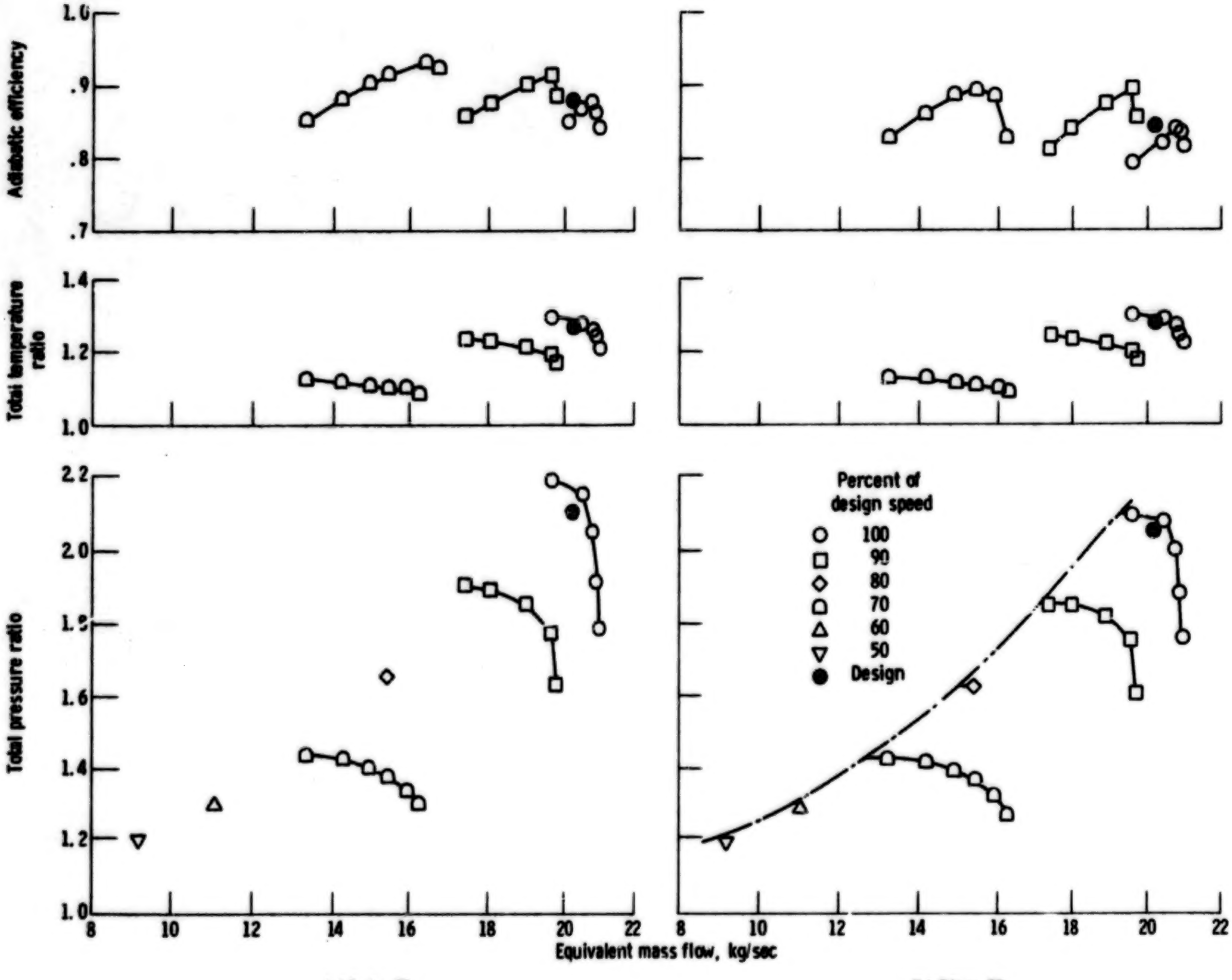
Figure 21. - Overall performance for configuration 35.



(a) Rotor 36.

(b) Stage 36.

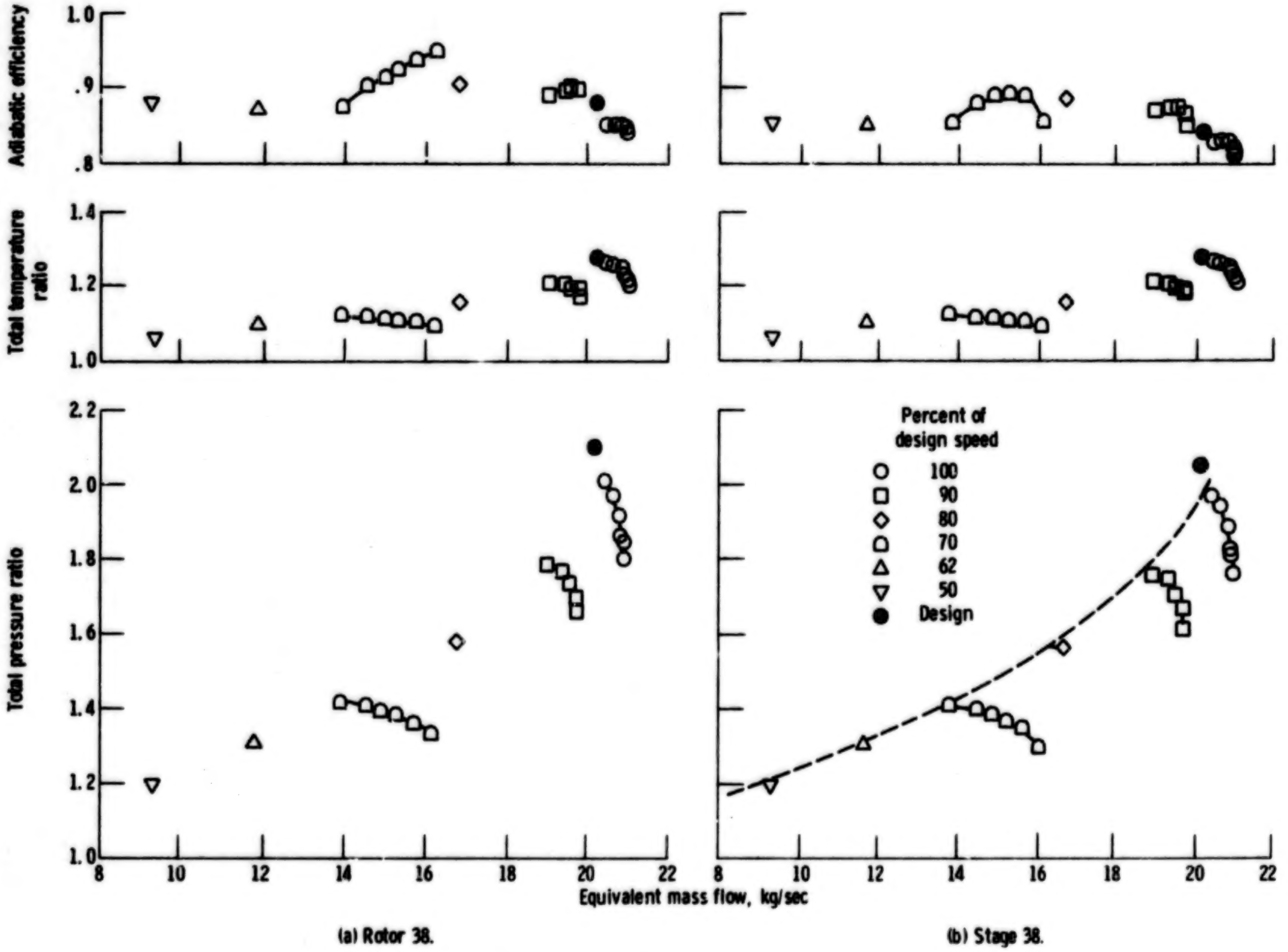
Figure 22. - Overall performance for configuration 36.



(a) Rotor 37.

(b) Stage 37.

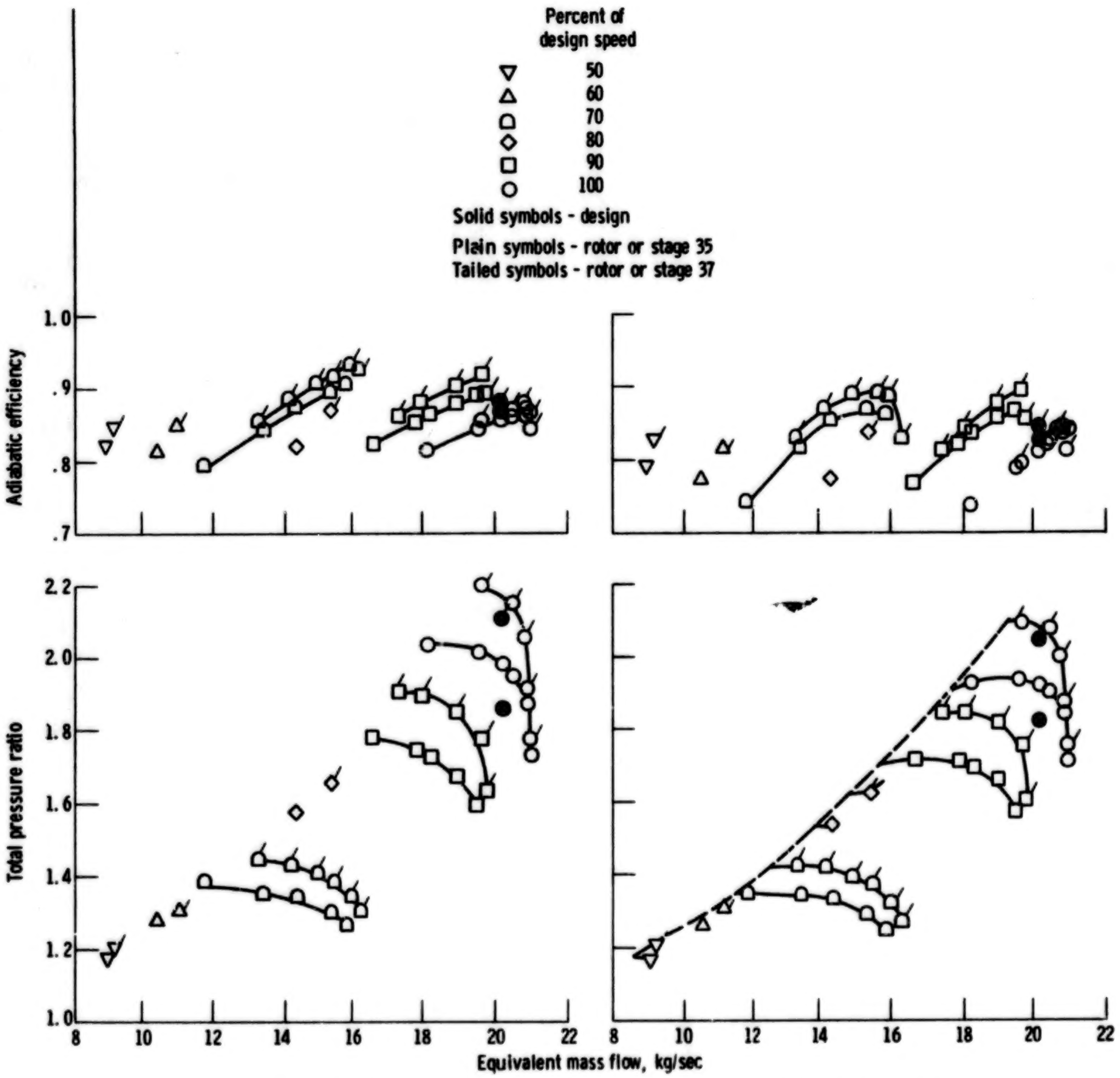
Figure 23. - Overall performance for configuration 37.



(a) Rotor 38.

(b) Stage 38.

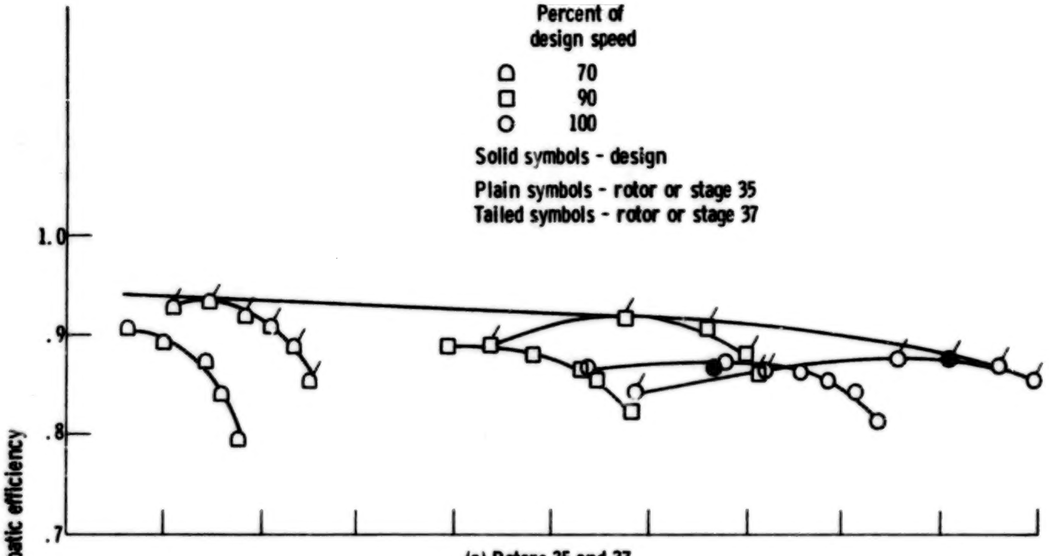
Figure 24. - Overall performance for configuration 38.



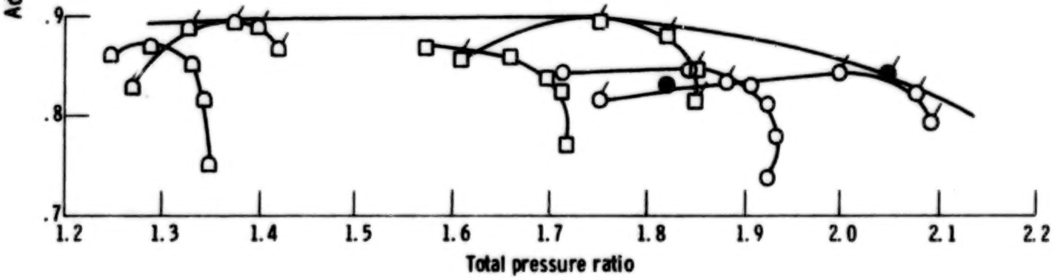
(a) Rotors 35 and 37.

(b) Stages 35 and 37.

Figure 25. - Effects of stage design pressure ratio on overall performance of 1.19 rotor aspect ratio configurations.



(a) Rotors 35 and 37.



(b) Stages 35 and 37.

Figure 26. - Efficiency for 1.19 rotor aspect ratio configurations.

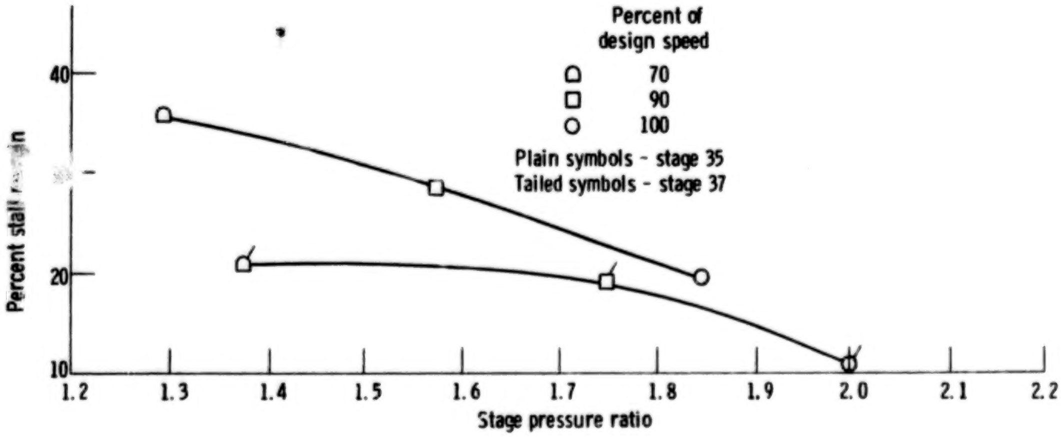
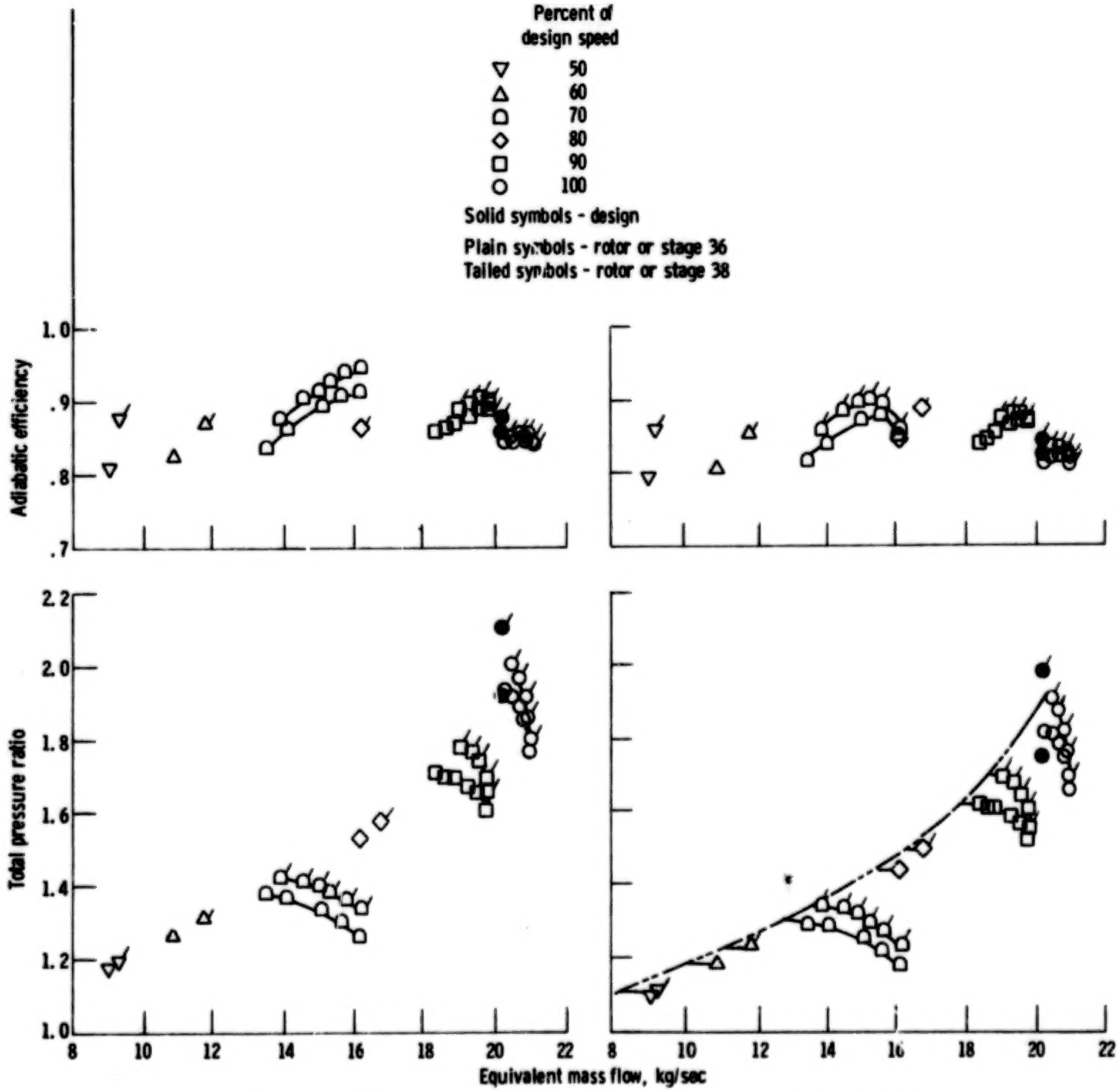


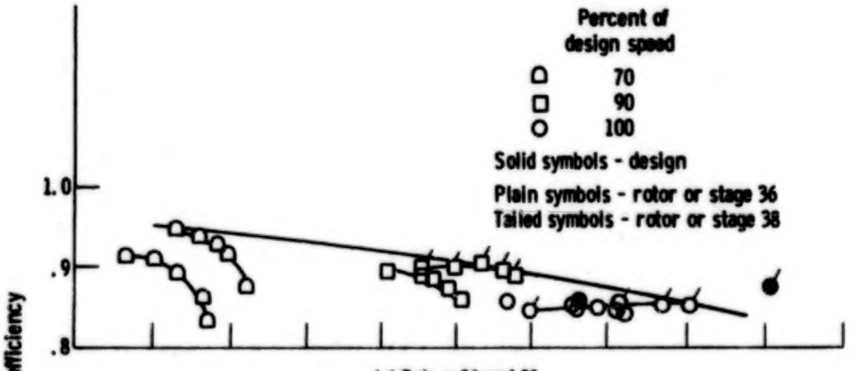
Figure 27. - Stall margin for stages 35 and 37.



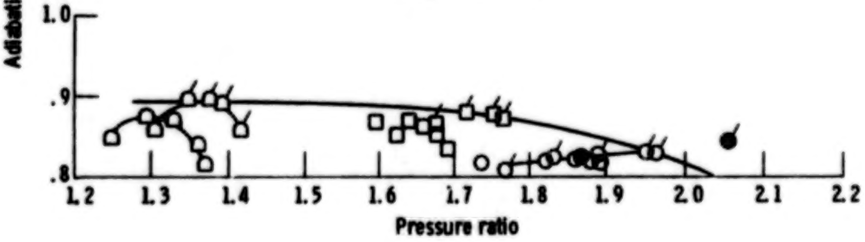
(a) Rotors 36 and 38.

(b) Stages 36 and 38.

Figure 28. - Effects of stage design pressure ratio on overall performance for 1.63 rotor aspect ratio configurations.

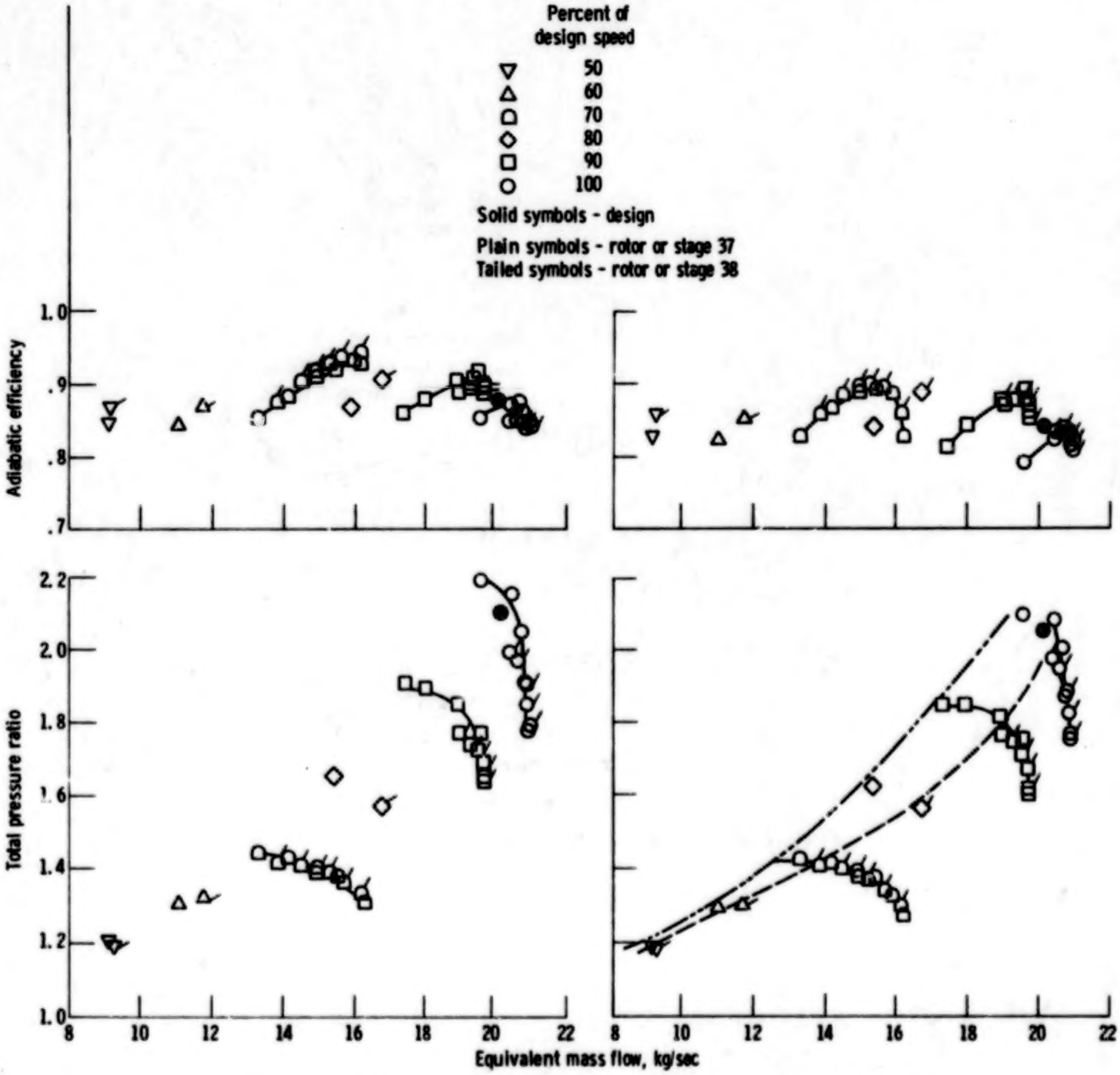


(a) Rotors 36 and 38.



(b) Stages 36 and 38.

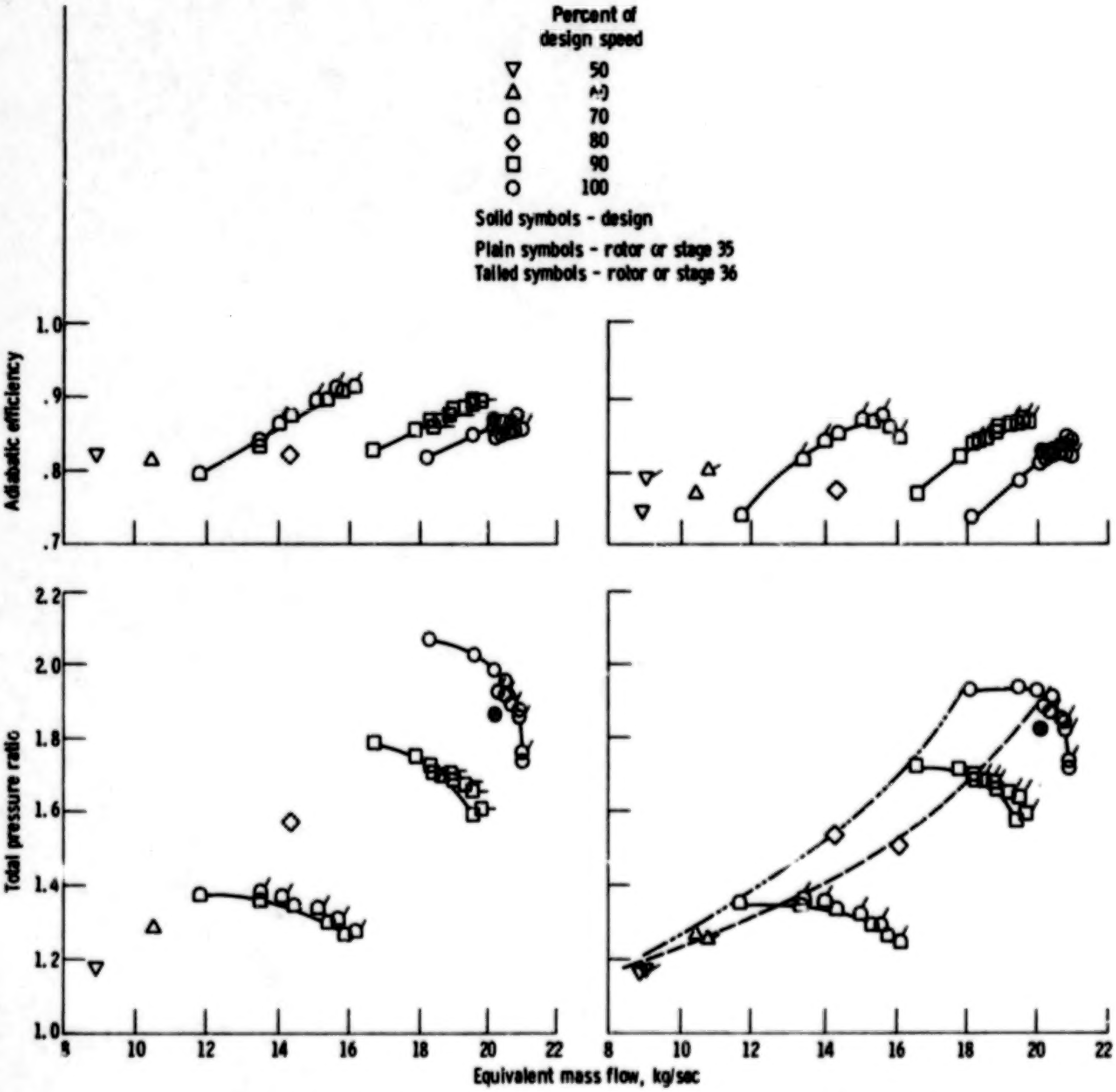
Figure 29. - Efficiency for 1.63 rotor aspect ratio configurations.



(a) Rotors 37 and 38.

(b) Stages 37 and 38.

Figure 30. - Effects of blade aspect ratio on overall performance of higher pressure ratio configurations.



(a) Rotors 35 and 36.

(b) Stages 35 and 36.

Figure 31. - Effects of blade aspect ratio on overall performance of lower pressure ratio configurations.

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16. Abstract

The detailed design and overall performances of four inlet stages for an advanced core compressor are presented. These four stages represent two levels of design total pressure ratio (1.82 and 2.05), two levels of rotor aspect ratio (1.19 and 1.63), and two levels of stator aspect ratio (1.26 and 1.78). The individual stages were tested over the stable operating flow range at 70, 90, and 100 percent of design speeds. The performances of the low-aspect-ratio configurations were substantially better than those of the high-aspect-ratio configurations. The two low-aspect-ratio configurations achieved peak rotor efficiencies of 0.876 and 0.872 and corresponding stage efficiencies of 0.845 and 0.840. The high-aspect-ratio configurations achieved peak ratio efficiencies of 0.851 and 0.849 and corresponding stage efficiencies of 0.821 and 0.831.

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